SCIENCE

AN ILLUSTRATED JOURNAL

PUBLISHED WEEKLY

VOLUME V

JANUARY–JUNE 1885

CAMBRIDGE MASS.
THE SCIENCE COMPANY
1885

Franklin Press:
RAND, AVERY, AND COMPANY,
BOSTON.

INDEX TO VOLUME V.

*** *Names of contributors are printed in small capitals.*

LIST OF ILLUSTRATIONS.

ERRATA.

Page 31, col. 2, 13th line from bottom, for 'Sept. 26' read 'Nov. 17.'
" 32, " 1, 8th line from top, for 'Hypatia' read 'Coelestina.'
" 32, " 1, 9th line from top, for '(238)' read '(238) Hypatia.'
" 74, " 1, 6th line from bottom, read "337 tons of coal per day, which gives combustion at the rate of over 1,500 pounds of coal for each mile traversed."
" 97, " 1, 22d line from top, and under cut, for 'Palaeophoneus' read 'Palaeophonus.'
" 97, " 1, 14th line from bottom, insert 'then' between 'the' and 'earliest-known.'
" 248, " 2, in several places, for 'Cortez' read 'Cortes.'
" 248, " 2, 13th line from top, for 'Titacat' read 'Teutiaca.'
Page 311, col. 1, 26th line from bottom, for 'Bosukop' read 'Bossekop.'
" 311, " 2, 2d line from bottom, for 'Lecbi' read 'Lieber.'
" 312, " 1, 2d line from top, for 'Robesen' read 'Robeson.
" 361, " 2, 28th line from bottom, for 'northern' read 'southern."
" 361, " 2, 13th line from bottom, for 'to the south' read 'to the north.'
" 362, " 2, 2d line from bottom, for 'In 1883' read 'In 1881.'
" 472, " 1, 18th line from bottom, for 'culture-medicine' read 'culture-medium.'
" 492, " 2, 6th line from bottom, for 'acid' read 'oxide.'
" 514, " 1, 5th line from bottom, for 'Byron' read 'Byrom.'
" 514, " 1, 28th line from top and under cut, for 'Brasenice' read 'Brasenia.'

CONTENTS OF VOLUME V.

SPECIAL ARTICLES.

BOOK REVIEWS.

SCIENCE.

AN ILLUSTRATED JOURNAL PUBLISHED WEEKLY.

Vérité sans peur.

CAMBRIDGE, MASS.: THE SCIENCE COMPANY.

FRIDAY, JANUARY 2, 1885.

COMMENT AND CRITICISM.

THE AWARD by the Royal society of London of the highest honor in its gift, the Copley medal, to Professor Carl Ludwig of Leipzig, has been the cause of much rejoicing among English physiologists. Since John Hunter received the medal nearly one hundred years ago (1787), no physiologist has so merited it by fruitful, lifelong devotion to the advancement of knowledge. Ludwig's first research was published in 1844; and still every year important investigations, inspired, directed, and often personally executed by him, are published from his laboratory. His work extends over nearly every branch of physiology, but we can here refer only to one or two of his more epoch-marking works. In 1850, by the discovery of secretory nerves, he added a new territory to the domain of experimental physiology. That wonderful series of researches on the circulatory mechanism, which commenced in 1847 with a paper on the influence of the respiratory movements on the blood-flow in the aorta, has continued to this day, almost every year adding something from the master's hand. The introduction of the graphic method into physiological experimentation we also owe to Ludwig; and he who would ask what the value of this has been, may be referred to almost the whole of modern experimental physiology for his answer.

Nearly all of the present generation of British physiologists have been students in the Leipzig laboratory. While there, they could not fail to acquire a warm personal affection for its director. Simple, kindly, possessed of a genial humor which never wounds, enthusiastic in his work, and ever ready with aid and counsel, Ludwig must be beloved by those who work under him: hence, to their pleasure in a worthy bestowal of the Copley medal, English physiologists have the further joy of seeing a beloved master publicly honored. In both these respects they will have many warm sympathizers in the United States. For years the Leipzig laboratory has been the headquarters abroad of young American as well as English physiologists; and at present Ludwig is represented by pupils on the physiological staff of the Harvard medical school, of the University of Pennsylvania, of the Johns Hopkins university, of the University of Michigan, and probably of other American institutions. In fact, so far as physiology is now pursued and taught in this country as a definite independent science, and not as a mere body of more or less dubious dogmas which custom makes it necessary to include in the medical student's curriculum, it is, for the most part, pursued and taught by or under the direction of those who have been Ludwig's pupils. In their name we congratulate the master, and express the hope that he may yet be spared for many years to carry on his work.

WE HAVE had occasion twice during the past year to remonstrate against the methods employed by certain book-dealers in bringing out quasi-scientific books. In June, mention was made of several volumes that appeared without date. In November it was the question of more sincere discrimination on the part of publishers in regard to the quality of the material that they recommend to the purchasing public. Now, the little book on meteorology mentioned in our notes provokes protest against the practice of borrowing illustrations and extracts without acknowledgment of their sources.

There are four plates in the first part of this book, the only pictures it contains; and they are all taken from the work on storms by Blasius. In the 'Scholia' of the second part, there are several papers by well-known meteorologists: some of them are credited to their original place of publication; but several others are appropriated, in a more or less condensed form, with their author's name at the head of each, as if, in distinction to the first, these were written expressly for this book. It may be that the omission of acknowledgment results simply from carelessness; but, in any case, it is not to be lightly excused. Why should not professors demand as much care in these matters from their publishers as from their students?

LETTERS TO THE EDITOR.

Why is water considered ghost-proof?

As a possible partial explanation of the fact referred to by Dr. Edward B. Tylor, in his address before the Anthropological society of Washington (see *Science*, iv. 548, col. 2), of the wide-spread belief among savages 'that water is impassable to spirits,' the obstacle which it presents to dogs in pursuing their prey by scent may be suggested. This latter fact must be well known to most uncivilized races; and the mystery of tracking by scent must furnish a fertile theme for the exercise of the savage imagination, while the scent itself of a human being would be readily attributed to his spirit. Can anthropologists show any 'historical connection' between the fact and the belief? LESTER F. WARD.

Hollyhock-disease and the cotton-plant.

The hollyhock-disease has been a bane to European gardeners for ten years past. It is one of the most destructive of plant-diseases; being able to kill young plants within a week from the time of its attack, and making sad havoc wherever it appears. It is a parasitic rust (Puccinia malvacearum Mont.) to be associated with the rusts of wheat and oats, and is not confined to hollyhocks, but attacks many other members of the mallow family, such as the upright mallow in particular, marsh mallow, German Lavatera, the common weed known as Indian mallow or velvet-leaf, and many others. Winter gives a list of twenty-four species.

The disease was introduced into Europe from Chili in 1869, appearing first in Spain. In four years it had spread through France and the southern portions of Germany and England, reaching northern Germany in 1874, and Ireland in 1875. It has also appeared in Australia and the Cape of Good Hope, but has not yet, in all probability, invaded North America. The plant reported under this name from California is doubtless another species, as I am informed by Dr. Farlow, who has examined Californian specimens, although not those of the original collector. The mention by Burrill of its introduction into this country is an error, as I have learned from the author. A disease sometimes spoken of in American journals under this name is due to an entirely different cause.

Its introduction from Europe, which is most likely to occur through the importation of hollyhock-seeds, should be guarded against. But a still greater interest attaches to the disease in regard to its possible relation to the future of the cotton industry. The cotton-plant is a member of the mallow family, and, so far as one may judge *a priori*, would fall a ready prey to the disease. It occurred to me to obtain some disease-spores from Europe, and test their growth on cotton; but, fearing the disease might escape from my control, I finally interested my friend, Mr. Charles B. Plowright of King's Lynn, Eng., in the subject, who offered to undertake the necessary experiments.

Mr. Plowright reports, under date of Nov. 26, as follows:—

"Six young cotton-seedlings were, on July 12, infected with germinating-spores of Puccinia malvacearum. The plants were quite young, and the spores were applied to the cotyledons. No result.

"Six young cotton-plants which possessed true leaves were, on June 19, infected with P. malvacearum. No result. June 29, infected same plants again. No result.

"In July these plants were planted out in the garden; and beside them a healthy specimen of Malva sylvestris was also planted. At the beginning of August, four small Malvae, affected with the Puccinia, were planted so near the cottons and healthy mallow that the diseased foliage of the one touched the healthy foliage of the other.

"Aug. 20. The healthy mallow has become affected with the Puccinia: the cottons have not. The plants were left growing together to the end of summer, but the cotton-plants remained free from the Puccinia until they died from the cold of autumn some time in October."

It is a relief to find that our apprehensions regarding the dire consequences that might follow the introduction of this destructive rust are without foundation, so far as the cotton-plant is concerned. The mallow family is divided into two tribes; the first including the true mallows, and the second the rose mallows. Among the best-known members of the latter are the shrubby Althaea, okra, and cotton. I am unable to find any record of any of this tribe taking the disease, and it is probable that the true mallows only are subject to it. J. C. ARTHUR.

N.Y. agric. exper. station, Geneva, N.Y.

Military cetology.

In the exhaustive essay upon brush-making, by Capt. A. L. Varney, in the last report of the secretary of war (vol. iii. p. 190), I find, in connection with much information of interest to the zoölogist, some remarks upon cetaceans which are unique in their way, and show how dangerous it is for one unacquainted with a subject to attempt to instruct others therein. After stating that "whalebone, or baleen, is a horny substance, consisting of fibrous laminae *laid lengthwise along the upper jaw of the whale*," our author proceeds to give the following information about the order Cetacea in general:—

"Zoölogically, whales, or mammalia of the cetacean order, are divided into two great families, —'blowing' cetacea, so called from the habit of spouting water through the nasal openings or spiracles in the top of the head; and 'herbivorous' cetacea (Manati). The family of 'blowing' cetacea is divided into two tribes, —the tribe of whales (Balaena); and the dolphin tribe, distinguished mainly by the size and shape of the head.

"The whale tribe (Balaenidae) is divided into the genus whale and the genus cachalot (sperm whale). The genus whale produces the baleen," etc.

This travesty of truth was evidently compiled from text-books of fifty years ago, and, although somewhat amusing from its complete erroneousness, cannot be too severely criticised. Cetology is certainly not in so advanced a condition as could be wished; but there are numerous recent works in which the outlines of the subject are correctly laid down, and from which our author might have gathered facts, and not fictions, with which to preface his chapter upon whalebone.

FREDERICK W. TRUE.

U. S. national museum.

Man in the stone age.

In *Science*, iv. 469, Prof. Henry W. Haynes takes me up sharply in reference to an opinion I expressed about the epoch of the appearance of man, properly so called, in prehistoric time in Europe, and calls this opinion 'a most amazing travesty of the views of Mortillet.'

Professor Haynes tells us that he gave a critical notice of Mortillet's work, 'Le préhistorique; antiquité de l'homme,' in *Science:* it is probable, therefore, that he read that book. But it is evident, that, if he did, he has forgotten it: otherwise he would not repeat that Mortillet takes the station St. Acheul as typical of the oldest stone age, inasmuch as he definitely rejects it as being of mixed later types, and substitutes the station of Chelles (*op. cit.*, 133). He would also have remembered that Mortillet denies, in so many words, that the anthropoid then living was man as we understand the term. These words are, "Nous nous retrouvons, donc, en présence de l'anthropopithèque, dont j'ai démontré l'existence," etc. (p. 248). Passing to the next age or epoch, the Moustérien, he asserts that it, too, was characterized by this race of anthropopitheci (p. 339); while in the third epoch, that of Iolutré, he leaves the question open, denying that any traces of man or anthropoid have been discovered (p. 392).

This brings us late, very late, in paleolithic time, without an osteologic trace of any being who should properly be called *man;* for it would indeed be a travesty to apply that name to a creature without language, without religion, and without social compacts. If the question is to be any thing beyond one of word-splitting, these psychological characteristics must be connoted by the word 'man;' for in all ethnological study they almost alone occupy us, as Peschel has well shown in his chapter, 'Die stellung des menschen in der schöpfung' (Völkerkunde, einleitung). Yet Mortillet himself denies them to his anthropopithecus. DANIEL G. BRINTON, M.D.

Media, Penn., Dec. 13.

Dr. Haacke's discovery of the eggs of Echidna.

In the *Zoologischer anzeiger* of Dec. 1 appears an extremely interesting letter from Dr. Wilhelm Haacke, director of the South-Australian museum at Adelaide. It is dated Sept. 8, and contains an account of the writer's independent discovery of the oviparous character of the monotremes four days before Professor Liversedge transmitted Mr. Caldwell's famous cable from Queensland.

On Aug. 3 last, Dr. Haacke received from Kangaroo Island, a point about one day's journey from Adelaide, a living female Echidna hystrix. With the deliberateness characteristic of his race, he did not examine the animal until Aug. 25. He then ascertained that there were two lateral folds of the mammary pouch, in one of which he felt a small object. In the expectation of finding a young Echidna, he brought it to light; and, to his astonishment, it proved to be an egg, with a membranous shell like that of some of the reptiles, and measuring about two centimetres in diameter. Owing, probably, to the long confinement of the animal, the egg was decomposed, and broke apart under a slight pressure.

On Sept. 2 this important discovery was quietly communicated to a meeting of the Royal society of South Australia; and the Adelaide *Advertiser* of Sept. 4, also the *Register* of Sept. 5, published the fact in their reports of the meeting. In the same number of the *Register* appeared a cable-message from London, announcing Mr. Caldwell's discovery of the eggs of Ornithorhynchus; in which message, probably through a telegraph-operator's error, the word 'viviparous' had been substituted for 'oviparous.' Dr. Haacke immediately wrote to the *Register* in a letter printed on the 6th, pointing out the probable error, and the singular coincidence of the independent discoveries of Mr. Caldwell and himself.

On Sept. 7 the *Register* published an extended account of Mr. Caldwell's researches in Australia, and added in a shorter note, —

"It may also be observed that the announcement which has caused such a sensation among European scientists was made from Queensland on Aug. 29, or a few days after the discovery by Dr. Haacke."

Dr. Haacke closes his paper in the *Anzeiger* with an expression of pleasure that his discovery had met with such an unexpectedly rapid confirmation at the hands of another observer.

This adds another to the numerous coincidences in the history of scientific discoveries. When it is remembered that Mr. Caldwell, at the time of his discovery, was in the interior, and may have been some distance from any telegraphic station, it seems probable that his observation and Dr. Haacke's were only a day or so apart. At all events, each investigator is entitled to the full credit of independent discovery, or perhaps, in view of Professor Gill's recent letter to *Science* on this subject, we may better say confirmation of an old truth that has been disregarded for half a century. After so long a period of ignorance regarding this most important question concerning the monotremes, it is certainly very extraordinary that at points so distant from each other there should have been made, simultaneously, observations upon different genera, either of which practically solved the question for all time.

HENRY F. OSBORN.

Princeton, N.J., Dec. 19.

Artificial wampum.

During a discussion upon wampum, at the Montreal meeting of the British association, I alluded to the fact that there is a wampum manufactory at Paskack, N.J. In the same discussion Major Powell remarked, that, according to his belief, none of the cylindrical beads of which the belts then on exhibition were composed had been made by Indians.

Since my return I have visited the manufactory mentioned above, and I will give a hasty sketch of the same. It is situated at Paskack, on the Hackensack River, and is conducted by four 'Campbell brothers,' the youngest of whom is about seventy years of age.

According to their account, the business has been in their family about four generations. During the life of their grandfather it was situated at Tenack, now Edgewater; and my informant remembers when his grandfather used to go in a boat to Rockaway, and

return with his boat loaded with clams, the meat of which was given to the country-people in return for opening the shells, as they were ruined by boiling. The blue 'heart' of the clam, as it was called, was cut out, and made up into the beads used for the ground-work of belts. My informant said, further, that he had often paid out thousands of dollars per week, buying the beads of the white country-people, who manufactured them in their several homes. The hole of the bead was made with an 'arm drill,' and the beads were polished or rounded on grindstones. He says the white beads cannot be made from clam, but from conch shells, which they have always imported from the West Indies. The young clams cannot be used, and the old have so decreased in number that this branch of the industry has been greatly reduced.

I had with me an Iroquois wampum belt, bearing the marks of age, which they immediately pronounced to have been made after their manner. Although they had been familiar with Indians, they had never known of their making the beads. They had always depended upon the trappers for their market, and related incidents connected with their dealings with 'fur companies,' etc. The conch-shell is used also in the manufacture of the pipe beads, rosettes, etc. The holes in the pieces composing the rosettes are drilled, some of them, by the country-women in the vicinity. Specimens of the latter I shall take to New Orleans to represent a minute branch of the industry.

If desired, I will resume this subject at a future time, and will present other proofs which go far towards supporting the statement made by the director of the Bureau of ethnology.

ERMINNIE A. SMITH.

Was it imagination?

The note on artificial auroras, in *Science* for Nov. 14, reminds me of an experience which occurred to myself and party on a mountain summit two or three years ago. There was an unusually brilliant aurora, and it was remarked by several that the streamers seemed to be very near us; and presently, as we stood in the open air with heads uncovered, we began to feel the sensations produced by proximity to a body charged with electricity. The fact that such a sensation had actually been produced by the aurora, was doubted by some scientific men to whom I mentioned it; and it was attributed to *imagination*, which, I fear, is guilty of much, and often accused of more. My object now is chiefly to inquire whether others have had a similar experience. If, during the exhibition of an aurora, such an artificial pillar of light can be formed, I see no reason for doubting the evidence of my own senses; which, by the way, was so definite, and so distinctly perceived, that I could not doubt it if I desired to do so. E. T. QUIMBY.

THE MANAGERS TO THE READERS.

IT is not often that the managers of this journal feel disposed to address their readers with editorial directness. Our principal duty is to record with fidelity and promptness the progress of science, and to make such comments upon its achievements as will enable intelligent people to follow with ease the course of inquiry in departments which are remote from their daily avocations. But the opening of a fifth volume furnishes us an opportunity for a few retrospective and prospective observations.

We have successfully passed what is sometimes called 'the dangerous second year.' A more intimate acquaintance with our staff of contributors, and a more accurate knowledge of the requirements of our readers, have enabled us from time to time to modify our original plans, and to adapt them more closely to the actual scientific condition of the country.

We are constantly exposed to contrary tendencies. The cry often reaches us for 'more popular' articles. The public appetite, which has been whetted for half a century by museums, lectures, magazines, books, and tracts, revealing the 'wonders of science,' 'the curiosities' of nature, the mysteries of the microscope, the magnitudes of the telescope, and other like marvels, calls upon us to give more entertaining and sometimes more sensational papers. When this desire is somewhat moderated, it still looks for novelties, surprising discoveries, extraordinary announcements, and is liable to disappointment if our weekly issue appears with 'nothing striking in it.' On the other hand, the teachers and leaders of science would generally be glad to have this journal become more scientific, and less popular, by printing longer papers than we commonly offer, more abstracts of important memoirs, more elaborate discussions of controverted points. Between these two opposing tendencies, it is no easy task to keep a steady course. A brief recapitulation of our principles may enable our readers to understand our position.

In the first place, *Science* aims to gather from original American sources early and trustworthy information in respect to the scientific work which is in progress in every part of this land and under all the various agencies, governmental, institutional, social, and individual. We do all in our power to elicit from the universities, the learned societies, the laboratories, the surveys, the observatories, and the national scientific departments, accurate

MAP OF THE DISTRICT ABOUT THE LOWER KONGO.

AFTER CHAVANNE.

and frequent communications in respect to matters which come under their cognizance.

Second, *Science* aims to gather like reports from the best British and foreign sources in respect to the advancement of knowledge in other countries. In respect to work which is done abroad, where there are so many excellent journals, we cannot be so full as we are in respect to the investigations of our own countrymen; but, as science knows no geographical restrictions, our columns are open to intelligence from every part of the globe.

Third, in presenting what we have to say, our purpose is to be brief, as becomes a journal published weekly; alert in selecting those topics which are of the most immediate interest; accurate, or we should soon lose all standing in the scientific world; and readable, by which we mean that the articles written by specialists in their several domains shall be phrased in terms comprehensible, without a dictionary, to those whose studies and pursuits are in very different fields.

Fourth, in the discussion of important questions, or in the expression of opinions on disputed points, *Science* endeavors to be free from the influence of any school or clique, to speak only in the interests of advancing truth, and to suggest such methods as will promote the economical employment and enlargement of scientific funds, the diffusion of sound ideas among the people at large, and the suppression of all needless animosities.

As for the future, we are hopeful. Our arrangements for receiving and printing such communications as we wish to lay before our readers were never better than now. Our contributors, many of whom we have never personally seen, and who are scattered far and wide over this land, have never been in better accord with the editorial staff. Our subscription list is enlarging, and our pages now come before the principal workers in all departments of science. But we are free to add, that if *Science* is to be all that it should be, all that we desire to make it, there must be a more liberal financial support. Those who have furnished the capital requisite to begin and to sustain for a period the publication of a journal which they believed would be of the greatest utility cannot be expected to continue their support indefinitely, unless they are sustained by the cordial support of individuals and associations who are interested, quite as much as the directors of *Science*, in the perpetuation of the influences which we now represent.

We therefore ask our readers and friends, and especially our contributors and subscribers, to continue during a third year their hearty and outspoken good will.

THE KONGO.

Ten years ago Stanley left Zanzibar for the great lakes of eastern Africa, intending, if possible, to cross the continent, and ascertain if the Luluaba of Livingstone was the Kongo. We then knew little of central or western Africa. The courses of the streams and mountains dotted on the map were derived from imagination or the vague reports of natives. Schweinfurth had explored Sudan and Darfur and the western branches of the Nile; but nearly all of Africa south of Algeria, and west of the Nile and the great lakes, was unknown. Since then, Stanley has followed the course of the Kongo nearly two thousand miles, from the great lakes of western Africa to the ocean.

The English have explored the Niger and its tributary, the Benue, nearly to Lake Tschad; while Capt. Cameron has crossed from Zanzibar, south of the watershed of the Kongo, to the Atlantic at Benguela. The Portuguese, under Messrs. Capello and Ivens, and De Serpa Pinto, starting from Benguela, 12° south latitude, about three hundred miles south of the Kongo, have traversed the continent between the 12th and 15th degrees of south latitude, and explored a vast tract of country and the valley of two great rivers running north, but were prevented by the natives from following them to their junction with the Kongo.

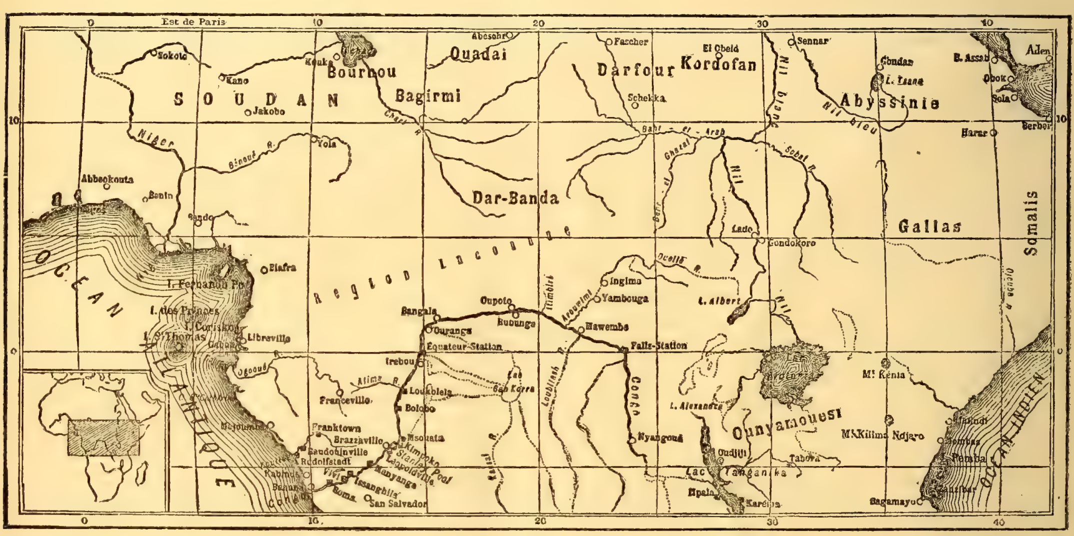
We have now a general knowledge of Africa from 10° north of the equator to the Cape of Good Hope, including central and south Africa; leaving only the territory south of Algeria, the western Sudan beyond Darfur, *terra incognita*. Into this region the French are travelling from Algeria, and the Germans from Egypt; and soon the whole of Africa will be explored, so far as its general features are concerned.

The western coast of Africa has long been

known to the slave-trader and the English cruisers. Since the suppression of the slave-trade, Portuguese, English, Dutch, and French traders have established factories or trading-stations at many places on the coast from 17° north to the Cape. On the Niger and its tributary, the Benue, are many English stations; and small steamers run regularly up and down these rivers, carrying in the cotton of Manchester, and bringing away the products of Africa. Within the last two years the Germans have established trading-stations at three different places on the western coast.

This country has been regarded as the most unhealthy portion of the world, lying under the equator; the soil low and marshy; the climate moist, damp, and malarious; the abode of all kinds of tropical fevers. The Kongo was barred by great falls near its mouth, and was so unhealthy, that out of a party of fifty-one, under English officers, who explored the river in 1816, only one returned alive. Now on the Kongo, above the falls, are between forty and fifty trading-stations, with small steamboats running from Leopoldville on Stanley Pool, three hundred miles from its mouth, to Stanley Falls, nine hundred miles from Leopoldville. While on the coast the country is low, flat, and unhealthy, south of the equator it rises a short distance from the coast, until it reaches a level of from twelve hundred to fifteen hundred feet. The Kongo, king of African rivers, and second only to the Amazon in the volume of its waters, occupies an elevated plateau on both sides of the equator, with a free navigation above Leopoldville, according to Stanley, of 4,520 miles. In its valley there is an abundance of flowing streams. The drinking-water is magnificent; the temperature delightful, the thermometer ranging from 87° at noon, to 60° at two A.M. The land is rich, and adapted to the growth of most tropical and semi-tropical products, among which are India-rubber, gums, sugar, and cotton. The country is probably as healthy as the fertile prairies of our own great west, and capable of raising immense crops of all the tropical productions.

There are two seasons, — a wet and a dry. In the rainy weather a large part of the day is pleasant, storms arise suddenly and with little warning, thunder roars, lightning flashes, wind blows with great fury, rain pours down in sheets of water for an hour or two; then as suddenly the clouds pass away. On the coast the rainy season lasts from November to March; but in the interior, rains commence earlier, and continue later.

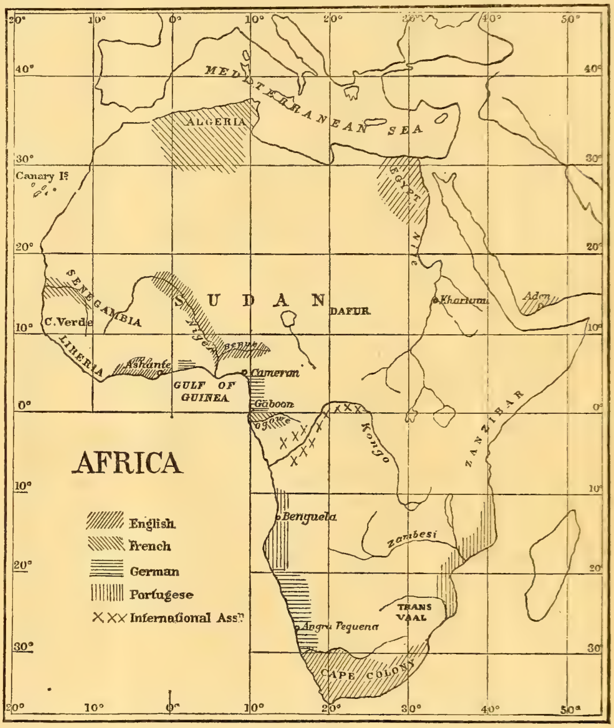


CENTRAL AFRICA, WITH THE COURSE OF THE KONGO.

There appears to be no great variety of races among the natives; though the tribes are very numerous, each, with a different dialect, living in constant warfare with its neighbors. Here are the dwarfs and many tribes of cannibals. The tribes inhabiting the coast have long been acquainted with the Portuguese and English traders; furnishing ivory and slaves in exchange for beads, fire-arms, ammunition, rum, and a little cotton cloth. These tribes, though anxious to trade with the whites, are opposed

to their travelling through the country, preferring to hold all the trade of the interior in their own hands. The natives in the interior are generally well disposed to the white man, and ready for trade.

Which of the great powers shall control this trade is a question now agitating the civilized world. The Portuguese first discovered the western coast of Africa. They claim the territory from latitude 5° 12′ south to 18° 5′ south, including the mouth of the Kongo River, running from the coast indefinitely into the interior. Their northern boundary-line crosses the Kongo at Isangilla, about one hundred and fifty miles from the mouth. By the right of discovery they claim jurisdiction over the mouth of the Kongo and all commerce passing out of its mouth. The English claim large portions of the coast from about 6° or 8° north to 18° north, including the mouths of the Niger, and the whole country drained by the Niger and the Benue, the Gold Coast, Sierra Leone, and Senegambia. The French claim Cape Verde, the River Senegal (14° to 17° north), Cape Lopez, and the Gaboon from about 4° or 5° north of the equator to as many degrees south. The Germans, within two years past, at the suggestion of Bismarck, have taken possession of Lagos on the Bight of Benin, of Cameroon between the English and the French claims (about 5° north), and a vast country near Angra Pequena, commencing at 23° south, and running to Cape Colony, about 29° south, inland to Transvaal, — a territory said to be as large as Germany, Belgium, and Holland united. They have established over forty factories on the coast.



OUTLINE-MAP OF AFRICA, SHOWING THE PORTIONS OF THE COAST CLAIMED BY EUROPEAN NATIONS.

Almost all the western coast of Africa is now claimed by these four great powers. Portugal claims the exclusive control of the navigation of the Kongo; England, exclusive control of the Niger. A year ago Portugal proposed to make a treaty with England by which the respective rights of these powers to each of these rivers should be recognized. Great opposition was made, both in England and on the continent, to this alliance, and it has been abandoned.

The International association of Africa was formed in 1877 in Belgium, about the time of the return of Mr. Stanley from the 'dark continent.' Its headquarters are in Brussels. The object of the association is to acquire, by treaties with the natives, territory for the use and benefit of free states established under the care and supervision of the association. For this purpose it is declared that no custom-house duties are to be levied upon goods or merchandise brought into the territory, and that no greater rights will be granted to the citizens of one nation than to those of every other; that the Kongo, the great highway into central Africa, shall remain an international river, open to all civilizing influences, and to the legitimate commerce of every land. It is established to promote the public good, not private gain. It has made treaties with many different tribes, and founded thirty stations on the river. At these stations factories are established, and trade carried on by merchants with the natives. This association is unlike any other ever organized. The United States was the first to recognize its nationality, in April, 1884. Since then it has been recognized by several other European nations.

At the invitation of Bismarck, a conference of the leading nations of the world is

in session at Berlin, to establish, if possible, the political status of the association. Many hope that it will ratify the purpose of the association to establish free navigation on the Kongo. The Germans also demand free navigation with international control of the Niger, but are opposed by the English, who claim the exclusive jurisdiction and control, although expressing themselves as ready to grant the free navigation of the river to all nations.

The French, under De Brazza, have opened a line of Atlantic communication with the Kongo by the River Ogowe, near the equator, with stations on the Ogowe and the Kongo; thus obtaining an outlet from the valley of the Kongo, north of the territory claimed by the Portuguese. The stations of the French are generally on the north side of the Kongo, while those of the International association are upon the south.

It now seems as if the valley of the Kongo would be the most densely populated part of Africa. Its climate and soil are favorable for white labor. The great drawback is the falls near the mouth of the river; but, to the elevation of land which produces these falls, it owes its favored position. A railway is proposed from Stanley Pool to Boma, a distance of two hundred miles, — the head of navigation from the ocean. The Niger and the Benue are both navigable from their sources far into the interior, and consequently the land in the immediate valley of these rivers is low and unhealthy; while south of the valley of the Kongo the country is probably broken and mountainous, and therefore less fit for cultivation.

The maritime nations of Europe are seeking for the trade of Africa, but there seems to be nothing to warrant expectations of a large traffic with central Africa at once. The tribes, though numerous, are small and have few wants. One or two generations must pass before they can become even partially civilized, and acquire the needs of civilized life. Emigration from Europe must be slow, as Africa is not so well adapted as America and Australia to European emigrants; and not until America is densely populated will the overflowing emigration from Europe seek the heart of Africa. But the time will come when it will be densely populated, and its long rivers, its many and great falls, its immense lakes and high mountains, become the resort of a vast population.

GARDINER G. HUBBARD.

Washington, Dec. 26.

LAKE MISTASSINI.

PARAGRAPHS are going the rounds of the newspapers, representing that a great lake has recently been discovered in Canada, larger than Ontario, and perhaps as large as Superior itself. If this were true, it would certainly be a matter of great interest, and would naturally lead to the inquiry, how it happened that far-off Lake Superior should have been mapped, with an astonishing approach to general correctness of outline, as early as 1672, while this new lake remained to be discovered more than two hundred years later, notwithstanding the fact that it is at a comparatively short distance from a region where the Jesuits and fur-traders had many posts at the time the Lake Superior map was made.

The immediate cause of the paragraphs in question was undoubtedly a communication made to the geographical section of the British association, at its late meeting in Montreal, by the Rev. Abbé Laflamme, and the reference to this communication by Gen. Sir J. H. Lefroy, in his opening address before the section as chairman of that body. In this address Gen. Lefroy gives the impression that the discovery of this lake is something new and startling. He says, "That it should be left to this day to discover in no very remote part of the north-east a lake rivalling Lake Ontario, if not Lake Superior, in magnitude, is a pleasant example of the surprises geography has in store for its votaries" (*Proc. royal geogr. soc.* for October, 1884, p. 585.). On referring to the communication made to the section by the Rev. Abbé Laflamme, it does not appear, however, that there was any sufficient authority for this statement on the part of the chairman of the section; and, as the matter is one of considerable interest, it may be worth while to look a little more carefully into what is known about the lake in question.

The facts here to be presented will show that we in reality know no more about the size of Lake Mistassini than we did two hundred years ago; the reverend abbé himself, in his communication, doing little more than to say that there is in north-eastern Canada a lake whose dimensions are unknown, but which some persons believe to be of great extent; an 'old trader,' whose name is not given, 'seeing no reason to doubt' that it is 'but little inferior in size to Lake Superior.' There are several statements in the reverend abbé's communication to which exception might be taken; but it is sufficient to call attention to his mistranslation and misconception of the original account of the lake by Father Albanel, who says that it is reported that twenty days would be required to make the tour of it (*pour en faire le tour*). This the Rev. Abbé Laflamme has translated, 'twenty days to *walk* around it;' thus showing a singular misconception of the nature of the only possible means of exploration and communication in a region like that in question.

This lake, called by the first explorer of that region, Father Albanel, '*le lac des Mistassirinins*,' lies on the north side of the watershed between the St. Lawrence and Hudson's Bay, and is represented on nearly every

map of the region as being the head and reservoir of Rupert's River. Its existence was first made known in the *Jesuit relations* for the year 1671–72. The account there given consists mainly of the journal of Father Charles Albanel, who was associated with Monsieur Denys de Saint Simon and 'another Frenchman' in the exploration of the line of communication (apparently well known to the Indians, but which had never before been traversed by white men) between Lake St. John and Hudson Bay. The geographical details given in this account are exceedingly meagre; the chief items in regard to Lake Mistassini being that it is said to be so large that the circuit of it could not be made in less than twenty days of fine weather; that it is full of rocks, from which circumstance its name is derived; and that there was an abundance of fish and game in the vicinity. It does not appear that Father Albanel's party did more than traverse a small arm of this lake, as they were not on it more than one, or possibly two days.

So far as known to the writer, the first delineation of Lake Mistassini is on a map published by Jaillot in 1685, of which a manuscript copy belonging to the Kohl collection is in the State department in Washington, and temporarily, at the present time, in the possession of Mr. Winsor, librarian of Harvard university. It does not appear, however, from Mr. Kohl's notes attached to this map, whether the original was engraved or printed; but it is said to have been almost entirely compiled from original Canadian authorities. On it the lake in question bears the name of 'Ticmagaming.' That it is really the lake now known as Mistassini will be evident from what is said farther on.

This lake also appears under the name of 'Mistasin' on two maps published by H. Moll in 1715 and 1720. Its shape, however, as indicated on these two maps, is not at all like that given on the Jaillot map; neither is it the same on Moll's two maps. It is clear from the way in which it is represented by the latter, and especially from the manner in which the islands are scattered over its surface, promiscuously and very differently in the two maps, that nothing more was known about it by Moll than that there was a large lake in that position in which were several islands.

In Bellin's map (1744), which is found in Charlevoix, the same lake is given with a very different form from that which had been previously indicated. It is represented as forming three nearly parallel bodies of water with a general north-east south-west trend, and connected with each other by comparatively narrow channels. To the most north-western of these bodies of water the name of 'Lac des Mistassins' is given; to the middle one, that of 'Père Albanel;' and to the more easterly one, that of 'Lac Dauphin.'

In the map which forms the geographical basis of the Canada survey (geological) map (1866), this lake (here called 'Mistiashini') appears with a very different shape from that given on the Bellin map, and has the appearance of being in part laid down from surveys. The north-eastern and eastern portions, however, are indicated by a dotted line, from which the inference may be drawn that this part of the lake was unknown. It is a remarkable fact, however, that the form of the lake, as given on the Geological survey map, resembles quite closely that which it has on the Jaillot map, showing pretty clearly that the western side of the lake was laid down by the last-mentioned compiler from actual exploration.

This same outline, given on the Geological survey map in 1866, is repeated without variation on the latest general map of Canada, — that published by Stanford, and said to be Arrowsmith's, with additions and corrections bringing it down to 1880. This would indicate that no additions had been made to our knowledge of the geography of that region during the past twenty years. It is a curious fact, however, that on the Arrowsmith-Stanford map, this lake, called 'Mistassinnie,' is moved just one degree farther to the east than it is on the Geological survey map.

On most of the maps on which the lake is given, it is represented as being some sixty or seventy miles in length, or about half the size of Lake Ontario: although it is clearly evident that its eastern side is unknown, both as to form and position. All that is known about its size, beyond this, is the statement of Père Albanel, that it was reported to be so large that it would require twenty days of pleasant weather to circumnavigate it; and the opinions of certain persons, reported by the Rev. Abbé Laflamme, giving it various dimensions, no clew being given to enable one to decide on the relative weight to be allowed to each person's opinion. The Rev. Abbé Laflamme gives his own statement, that there can be no doubt that Lake Mistassini is larger than Lake Ontario; while the 'old trader,' as already mentioned, says that there is no reason to doubt that it is 'but little inferior in size to Lake Superior.' The positive statement of 'Mr. Burgess' is also added, that the lake is a hundred and fifty miles in length: this would be about fifty miles less than Ontario.

After all, we have, in reference to the dimension of Lake Mistassini, no better evidence to fall back on than that of Father Albanel. What number of miles can be allowed as the equivalent of a tour of twenty days of fine weather, the writer, with the experience of seven summers spent in boating and canoeing on Lakes Superior, Michigan, and Huron, with crews of Indians, half-breeds, and *voyageurs*, is unable to say. An ordinary journey of twenty days in a canoe would, perhaps, carry a traveller around a lake half or two-thirds the size of Ontario, which would coincide with Mr. Burgess's statement.

While it is possible that Lake Mistassini may be considerably larger than Lake Ontario, the probabilities are decidedly in favor of its being somewhat smaller. At all events, geographical information in regard to that region, which does not seem difficult of access, is greatly needed.

It is easy to see from the above that the name of the lake about which this note is written has been spelled in as many different ways as there are authors or cartographers who have had to do with it. The spelling 'Mistassini' is here adopted because it is the

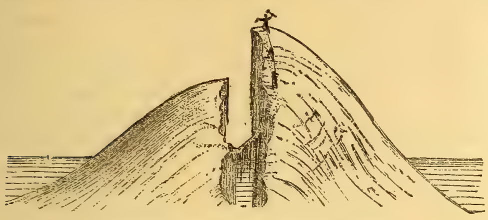
simplest, and because it is that form which has been used in the report of the proceedings of the Montreal meeting in the organ of the Royal geographical society. The present writer has, however, never seen it so spelled on any geographical map. It is spelled in three different ways in the publications of the Canada survey, and in the same number of ways in Stieler's 'Hand-atlas.' J. D. WHITNEY.

THE TASMAN GLACIER.

A YEAR ago, accounts were published of the attempt in 1882, of Mr. W. S. Green, an Englishman, to ascend Mount Cook, the highest (12,350) of the New-Zealand Alps. He was accompanied by two practised Swiss guides from Grindelwald, and reached a great altitude over snow and ice, but failed in his main object, chiefly on account of bad weather. A somewhat similar exploration was undertaken in March, 1883, by Dr. R. v. Lendenfeld of Christchurch, New Zealand, accompanied by his wife, three shepherds to serve as porters, and a driver for the wagon in which the supplies were carried up to within a few miles of the Tasman glacier. Bad weather on the approach to the mountains was followed by nine days without a cloud, during which a good piece of triangulation was executed, the Hochstetter dome ascended (2,840 m.), and material collected for a fairly detailed map on a scale of 1:80,000. The results of the survey now appear as supplement 75 to *Petermann's mittheilungen* (Der Tasman-gletscher und seine umgebung; Gotha, June, 1884, 80 p.), with a general and local map, a well-executed reproduction of a photograph taken from the medial moraine of the great Tasman glacier, which we copy in reduced form, and several cuts. The glacier was found to be twenty-eight kilometres in length, — three kilometres longer than the Aletsch, the greatest in Switzerland. Its lower part is of moderate slope and slow motion, greatly covered by moraines. Green described the New-Zealand Alps as equalling or exceeding those of Europe in picturesqueness, but Lendenfeld thinks them inferior. The mountain form is less pronounced, the snow-fields are smaller, and the glaciers are much obscured by morainic rubbish: bushes replace pines, and the flat-bottomed valleys are without villages and fields. The summit of the Hochstetter dome, a sharp edge of hard-packed snow, was reached by Lendenfeld, his wife, and one porter, after a daring climb across a delicate ice-bridge, of which the author's rough figure is here copied. Sitting astride

THE NEW-ZEALAND ALPS AS SEEN FROM THE MIDDLE MORAINE OF THE TASMAN GLACIER.

of the ridge, the neighboring peaks rose around them; and all New Zealand, from western to eastern coast, with the ocean beyond on either side, lay below. The



THE TOP OF MOUNT HOCHSTETTER.

story of the journey is simply and graphically told, and suggests a writer of more intelligence and better powers of observation than is usually met with among mountain climbers.

THE DIGESTIBILITY OF CELLULOSE.

It is a well-established fact, that a considerable portion of the woody fibre which is consumed in such large amounts by herbivorous animals does not re-appear in their excrements, but is apparently digested. In what portion of the alimentary canal, or by means of what secretion, this digestion is accomplished, has been the subject of much speculation and of some experiments; but, until recently, neither had done much to illuminate the matter.

Hofmeister [1] seemed to have gone far towards solving the question when he found that a considerable solution of the cellulose of grass took place in the rumen of sheep. He first enclosed two small samples of fresh grass in cages of german-silver wire covered with muslin, and introduced them into the rumen of a living sheep. After three days the animal was killed, the cages removed, and their contents examined. It was found that seventy-eight and four-tenths per cent of the woody fibre originally present had been dissolved. Subsequent experiments showed that the fluid obtained from the rumen of a freshly killed sheep had also a powerful solvent action on woody fibre, and that the mixed saliva had likewise this power. Experiments on oxen gave no decisive result: those on the horse failed to show any solvent action of the saliva upon woody fibre. Hay, and the 'crude fibre' prepared in the analysis of fodders, were acted upon by the fluid from sheep's rumen, though not so energetically as was the grass.

These results point unmistakably to the first stomach of ruminants as one place where cellulose is digested. Hofmeister ascribes to the mixed saliva the power of dissolving it; but some subsequent experiments by Tappeiner [2] indicate that this is effected by a fermentative process, and that the saliva or fluid from the rumen used by Hofmeister served simply to supply food to the organisms concerned in the fermentation. Tappeiner took samples of the contents of rumen, small intestine, and large intestine, of a ruminant fed exclusively on hay. One sample from each portion of the alimentary canal was at once boiled; to a second some antiseptic (chloroform, thymol) was added, sufficient to stop the action of organized ferments; while to the third nothing was added. All were kept warm, and after a time their content of crude fibre was determined. Those portions from the rumen and large intestine, to which nothing was added, were found to have lost cellulose, while carbonic acid and marsh-gas were evolved. No loss was observed from the contents of the small intestines, nor from the samples treated with antiseptics. Further experiments showed that this fermentation could be produced outside the body. To hay or pure cellulose, mixed with extract of meat, and previously heated to 110° C., a drop of fluid from the rumen was added. After a few days, active fermentation began. Gas was freely evolved, consisting of about seventy-six per cent of carbonic acid and twenty-four per cent of marsh-gas, and the cellulose nearly all disappeared. A second kind of fermentation was also observed, which yielded carbonic acid and hydrogen. In both kinds of fermentation, only the smaller part of the cellulose was volatilized, most of it being converted into acids of the fatty series.

That cellulose is fermentable is not a new observation; Van Tieghem having found that the butyric ferment has the power of decomposing it, with production of hydrogen, carbonic acid, and butyric acid. Tappeiner's experiments are of interest, because they show that the fermentation takes place also in the alimentary canal. This is shown not only by the disappearance of the cellulose in the experiments described above, but also by the presence of the products of the fermentation in stomach and intestines. In ruminants the marsh-gas fermentation seems to prevail. In the stomach of the horse and swine considerable quantities of hydrogen were found. In both cases acetic acid, aldehyde, and an acid having the composition of butyric acid, were found.

These results are important in their bearing on our estimates of the nutritive value of fodders. It having been shown that the digestible portion of the crude fibre has the composition of starch, it has generally been assumed to have the same nutritive value. Tappeiner's experiments show that this is probably not the case. There appears to be a disposition on the part of some critics, however, to rush to the opposite extreme, and, instead of overestimating the nutritive value of cellulose, to underestimate it. The non-nitrogenous nutrients are to be regarded as the fuel of the body, and they are of worth to it in proportion to the amount of energy set free by their oxidation to carbonic acid and water. So far as we can see, it is a matter of indifference whether that oxidation begins in the alimentary canal, or not until the substance has passed into the circulation. Whatever potential energy is contained in the digested cellulose is yielded up to the body sooner or later, with the exception of that portion which escapes in the form of combustible gases. According to Tappeiner, this

[1] *Biedermann's centralblatt*, Jahrg. x. p. 669.

[2] *Thier. chem. ber.*, xi. 303, xii. 266 and 272; *Zeitschr. für biologie*, xx. 52.

portion is small. Since, now, the heat of combustion of cellulose is the same as that of starch, according to von Rechenberg's determinations,[1] the difference in the nutritive value of the two must be measured by the heat of combustion of the marsh-gas and hydrogen evolved.

The well-known experiments of Henneberg and Stohmann on the respiration of sheep showed no considerable excretion of either hydrogen or marsh-gas. In one of them, for example, the animal ate per day 1,216 grams of hay, and excreted 1.5 grams of marsh-gas. Not having at hand the original account of the experiment, we will assume that the hay contained only twenty-five per cent of crude fibre, of which one-half was digested. This amounts to 152 grams per day. This quantity of cellulose, if oxidized to carbonic acid and water, would yield 676,704 cal.[2] From this we have to deduct the amount of heat carried off in 1.5 grams of marsh-gas, which, according to Favre and Silbermann, amounts to 19,595 cal. There remain 657,109 cal., representing the worth of the 152 grams of cellulose to the animal. The same weight of starch, if completely oxidized, would yield 680,808 cal.: in other words, the cellulose set free in the body of the animal ninety-six and a half per cent of the energy which the same weight of starch would have done.

Naturally these calculations are not exact; but they serve to show, that, if the heat liberated during the fermentation of the cellulose is of use to the animal, the nutritive value of cellulose does not fall so much below that of other carbohydrates as some are inclined to believe. H. P. ARMSBY.

IS THE RAINFALL OF KANSAS INCREASING?[3]

THIRTY years ago the territory of Kansas was not occupied by the white man, and, if we except a few acres cultivated by the Delaware Indians, no portion of her soil had been turned up by the plough. Her entire area was included within the vast and almost unknown region of the 'treeless plains' and the 'great American desert.' During that brief intervening period, more than a million people, chiefly of the agricultural class, have taken possession of her domain, and have already brought her to the very front rank of the states of the Union in the extent and value of her agricultural products. History affords no other instance of the permanent occupation of so extensive an area, previously unoccupied by man, by so large an agricultural population, in so short a space of time. Here, certainly, if human agency could anywhere affect climate, would such an effect be produced. Here, assuredly, if settlement ever increases rainfall, will such increase be most marked and most unmistakable. That such increase has actually taken place, I believe to be established beyond a doubt. It is a circumstance peculiarly favorable to the determination of the point in question, that, although the general settlement of Kansas by cultivators of the soil is of such recent date, reliable observations upon the rainfall had been made at the military posts upon the eastern borders for a sufficient period to make possible a satisfactory comparison between the rainfall before settlement and after settlement. The records at Fort Leavenworth cover the longest period, and enable us to compare the nineteen years immediately preceding the occupation of Kansas by white settlers with the nineteen years immediately following such occupation. During the first period the average rainfall was 30.96 inches; during the second period it was 36.21 inches; giving an average increase of 5.21 inches per annum, — an increase of nearly twenty per cent. The Fort Leavenworth records cover so long a period of time (nearly forty years), that the increased average of the second half of the period cannot be attributed to a mere 'accidental variation.' In the issue of *Science* for April 18, 1884, it is stated that "the supposed increase in the rainfall in the dry region beyond the Mississippi is not borne out by the returns of the signal-service." But the records of the signal-service upon which this statement was based include a period of only twelve years of observation (from 1871 to 1882), which is undoubtedly too short a period for either establishing or disproving the fact of a 'secular' variation.

But the fact of an increased Kansas rainfall does not rest entirely upon the Fort Leavenworth observations. There are other stations in Kansas whose records cover a much longer period than that of the longest established regular station of the signal-service. There are the twenty years' records of the U. S. military post at Fort Riley, the twenty-four years' records of the State agricultural college at Manhattan, and the seventeen years' records of the State university at Lawrence. If these several periods of observation be divided into two equal parts, in each case it is found that the average rainfall of the second half is notably greater than that of the first half. At Fort Riley the increase amounts to 3.05 inches per annum, and at Manhattan to 5.61 inches per annum, and at Lawrence to 3.06 inches per annum. Expressed in per cent, the rainfall of these three stations has increased in the second half of each period of observation, at Fort Riley, thirteen per cent; at Manhattan, twenty per cent; and at Lawrence, over nine per cent. If the increased rainfall could be shown by the records of a single station only, or if the several stations with sufficiently long periods of observation exhibited discordant results (some indicating a decrease, while others indicate an increase), or if even a single station indicated a diminished rainfall, the fact of a general increase would lack satisfactory demonstration. But the entire agreement of the four stations whose records have been used in a discussion of this question seems to establish beyond doubt the fact of an increased rainfall in the eastern half of Kansas.

There can be no reasonable doubt that the general

[1] *Journ. prakt. chem.*, n. f., xxii. 1 and 223.

[2] 1 cal. = the amount of heat required to raise the temperature of 1 gram of water 1° C.

[3] Lecture before the Kansas academy of sciences, Nov. 25, by Prof. F. H. SNOW.

settlement of the western portion of Kansas will have a similar effect upon its rainfall; but it is not reasonable to expect that western Kansas will ever boast of a rainfall equal to that of eastern Kansas. So long as the eastern half of the state remains to the east of the meridian forming the western boundary of the Gulf of Mexico, the south winds will cause it to receive much larger supplies of vapor, for condensation into rain, than will be received by the western half of the state, which lies beyond the immediate track of the vapor-laden winds. It must be remembered that climatic changes are exceedingly gradual; and a rain deficiency or excess for a single year, or for two or three years in succession, must not be considered as invalidating the law of general averages. Neither should the fact that the rainfall, upon the whole, is increasing, induce settlers to break land in the western third of Kansas with the expectation of successfully raising the same crops as in eastern Kansas. Such settlers will surely be disappointed. It is even doubtful if paying crops of any kind can ever be continuously produced in that region. With an average before settlement of about fifteen inches per annum, the same percentage of increase as has been made in eastern Kansas in thirty years would give an annual amount of less than eighteen inches, — a quantity entirely inadequate to maintain successful agriculture.

AMERICAN SOCIETY FOR PSYCHICAL RESEARCH.

AT a meeting held in Boston, Sept. 23, to consider the advisability of the formation of a society for psychical research in America, the whole matter was placed in the hands of a committee of nine, consisting of Dr. G. Stanley Hall of Johns Hopkins university; Prof. E. C. Pickering, director of the Harvard college observatory; Dr. H. P. Bowditch and Dr. C. S. Minot, of the Harvard medical school; Mr. S. H. Scudder, president, and Professor Alpheus Hyatt, curator, of the Boston society of natural history; Professor William James of Harvard college; Professor William Watson of Boston; and Mr. N. D. C. Hodges of Cambridge. This committee held a number of meetings during the months of October and November, and issued an invitation to a number of scientific men throughout the country to join in a society under a constitution upon which they had decided. To this invitation there were favorable replies from about eighty.

The first meeting of the society was held in Boston on the 18th of December. Under the constitution the conduct of the society is placed in the hands of a council of twenty-one, seven to be chosen each year, to hold office three years. Of this council, there were elected at this first meeting, fifteen: Prof. G. Stanley Hall, Prof. George S. Fullerton, Dr. William James, Prof. E. C. Pickering, for three years; Professor Simon Newcomb, Dr. C. S. Minot, Dr. H. P. Bowditch, Mr. N. D. C. Hodges, for two years; Prof. George F. Barker, Mr. S. H. Scudder, Rev. C. C. Everett, Mr. Morefield Storey, Professor John Trowbridge, Professor William Watson, Professor Alpheus Hyatt, for one year.

The sub-committee on work made an informal report, and has since issued a circular to members, asking for volunteers on the investigating committees and for information regarding promising subjects for investigation, such as mediums, mind-readers, mesmeric subjects, etc.

The society adjourned to meet on the ninth day of January.

THE NATURAL BRIDGE OF VIRGINIA.[1]

DURING a recent trip to Virginia (Oct. 2 to 6) I visited the Natural Bridge; and although in possession of the guide-book of the locality (edition of 1884), and the admirable articles published by Major Jed. Hotchkiss in *The Virginias*, I failed to obtain certain information relating to the bridge, which would be of special interest to the topographer and geologist. Some of the observations which I made, although of a general character, may be of interest.

The bridge is undoubtedly the remnant of the top of a cave which was probably formed long before the Luray cavern, which is excavated out of the same lower Silurian limestone formation. The bridge seems to be located in the centre of a gentle basin or synclinal in the strata, which may account for the roof of the ancient cavern being left at this special point. The height of the bridge has evidently been much augmented by a lowering of the bed of Cedar Creek through the agency of chemical and mechanical erosion after the destruction of the original cavern. The height of the original cavity, at the point where the bridge now exists, was in consequence very much less than the present height of the intrados of the bridge-arch.

The elevation of the railroad-track at Natural-Bridge station, on the Shenandoah valley railroad, is seven hundred and sixty feet above ocean-level; and the elevation of Cedar Creek, under the north face of the bridge-arch, is nine hundred and fifteen feet, as determined by two independent lines of barometric levels which I ran between the railroad-station and the bridge.

The height of the crown of the arch on the north side, at the 'Lookout Point,' is one hundred and eighty-eight feet above the creek, measured with a cotton twine, which was the only line of the required length which could be obtained. The same height measured by the barometer (Short & Mason aluminum aneroid) was determined as one hundred and eighty-six feet. Neither of these methods of measurement is sufficiently exact to permit of a final statement, but the results are of interest in the absence of more definite data.

The thickness of the arch under the crown on the north side is approximately forty-six feet, and on the south side thirty-six feet.

[1] Read before the American philosophical society, Oct. 17, 1884, by CHARLES A. ASHBURNER.

Much has been written and published about this natural bridge, since the appearance, a century ago, of a description of it in the 'Travels of the Marquis de Chastellux in North America in 1780–82;' but there appears to be a lack of a complete description of the bridge and its surroundings, which is readily available, and which would prove of special value to the topographer and the geologist.

HEREDITARY INTELLECT AND THE GEOGRAPHICAL DISTRIBUTION OF TALENTS.

THERE is hardly any subject more fascinating to men of intellectual pursuits than that of biography. Within the last few years we may almost assert that the foundations have been laid for a science of comparative biography which promises to be not only interesting as a branch of inquiry, but of practical importance to all who are engaged in the education of youth and the advancement of science. The writings of Galton, Ribot, James, and others, have shed a great deal of light upon the influences which tend to produce intellectual distinction; and, if investigations of this kind are far from being so comprehensive or so exact as would be desirable, they are, to say the least, suggestive and stimulating. To books of this class belongs the treatise which is named above. The volume is worthy of a much more extended and critical review than we can now give; but, having received an early copy of it, we bring it at once to the attention of our readers.

Eleven years ago Alphonse de Candolle, the celebrated botanist, who succeeded to the chair of his renowned father in the Academy at Geneva, and to the place of a foreign member of the French institute made vacant by the death of Agassiz, published a history of the modern sciences and of scientific men during the last two centuries. The work has long been out of print. Its venerable author, more than seventy-eight years old, has now issued a revised edition of this work, enlarged by more than a hundred pages of new material. Some portions of the original edition (particularly a defence of Darwin's theory of natural selection, which seemed to the author no longer called for) have been omitted, and in place thereof some new researches in respect to heredity in the human species have been introduced. By what he calls his new method, the author endeavors to distinguish in the facts of birth those which come from heredity, and those which are for the first time manifested in a family, and which may be considered as individual variations. These characteristics, and those developed after birth by exterior influences, determine the adaptation of the individual to the circumstances in which he is found; that is, to his environment.

De Candolle has now carried his inquiry beyond the ranks of those who are commonly called scientific men, — the students of mathematical and natural sciences, — and has made a study of those who are devoted to moral and social sciences.

It is not generally known how well he is fitted for both these lines of investigation. His career has been that of a botanist, but he began life by the study of law; twice he has been a member of constitutional conventions, and repeatedly of legislative bodies. We need say no more to assure the reader that this new edition of his history is fresh, suggestive, and instructive. If all its reasonings are not accepted, the student of comparative psychology must be grateful for the light which it sheds upon one of the most difficult, interesting, and important inquiries which can be made in respect to the intellect of man.

His new method, as he terms it, is this, — to select, without any preconceived notions, a certain number of individuals whose personal characteristics can be ascertained, and those of their parents and grandparents. The characteristics to be noticed are these: 1°, exterior physique; 2°, internal organs, so far as they can be judged without autopsy; 3°, instincts or native disposition; and, 4°, intellectual faculties. Having collected the facts, the influence of heredity can be approximately ascertained. The author first thought of studying the family of some sovereign, — Louis XIV., Frederick the Great, or some one else of whose ancestry there are abundant records; but he finally determined to study his own family. Being seventy-eight years old, he playfully says that he knows himself quite well. Of his parents and grandparents, all of whom lived to be more than sixty years old, he has a good recollection, supplemented by letters, memoirs, and portraits. He then noted in his subject 'A' sixty-four characteristics, of which he found sixty-three in one or both his parents. He extended his observation to thirty other individuals belonging to sixteen families; and in the entire group of thirty-one persons he was able to enumerate 1,032 characteristics of which he was able to state their presence or

Histoire des sciences et des savants depuis deux siècles. Par ALPHONSE DE CANDOLLE. Deuxième édition, considérablement augmentée. Genève-Bale, *Georg*, 1885. 594 p. 8°.

absence among the parents of the individual studied. The results of this inquiry are tabulated. To illustrate what he means by characteristics, the author cites three famous men whose lives are well known, and mentions their dominant traits, — Louis XVI. (fifteen characteristics), Napoléon Bonaparte (thirty-seven characteristics), and Charles Darwin (twenty-nine characteristics). All this part of his essay is full of interest.

His conclusions are these: —

1. Heredity is a general law which admits but few exceptions.

2. The interruption of heredity through one or more generations (atavism) is rare, perhaps five or ten times in a hundred.

3. The more remarkable a person is for good or ill, the more numerous and pronounced are his characteristics.

4. Women show fewer distinctive characteristics than men.

5. All groups of characteristics are more likely to be transmitted by fathers than by mothers.

6. It is difficult to determine whether characteristics which have been acquired by education and other external circumstances are transmitted by heredity.

7. The most marked characteristics in an individual are generally those received from both parents, especially those received both from parents and other progenitors.

The main portion of the volume, in the second as in the first edition, is a study of what might be called the origin and distribution of scientific men during the last two centuries. The author's views are based upon the selection of foreign members by three great academies, — in London, 1750–1869; Paris, 1666–1883; and Berlin, 1750–1869. As a rule, these associations bestow the honor of foreign membership, from time to time, upon men of all countries, and of all departments of study, who have exerted most influence upon the progress of science by their publications. Such elections may be regarded as indications of impartial judgment respecting merit; and, although there may be errors or prejudices, he believes that the aggregate lists include the names of those most worthy to be honored for their scientific investigations. From the facts thus collected he points out the proportion of mathematicians and naturalists at different epochs; the increasing devotion to a single subject; the rarity of feminine contributions to the progress of science; the social classes from which *savants* come; special influences which affect the number, the studies, and the successes of scientific men; national distribution of scientific leaders. Many valuable comments follow on the outlook of modern science, and the favorable and unfavorable influences which are at work. Toward the close of the volume, there is given an investigation (which was only approached in the first edition) respecting the academic recognition of men devoted to the moral and social sciences.

"The secret workings of nature which bring it to pass that an Aeschylus, a Lionardo, a Faraday, a Kant, or a Spinoza is born upon the earth, are as obscure now as they were a thousand years ago." These are the words with which Pollok introduces his life of Spinoza, and they have occurred to us after a perusal of the book we have described. The origin of genius or of talent is as fascinating an inquiry as the origin of species. But there is something in the intellectual or spiritual nature of man which eludes analysis, and hides itself from the most penetrating researches of the psychologist and the physiologist. Nevertheless, a volume so full of learning, so sparkling with bright ideas, so controlled by scientific habits, is a thought-inspiring book, for which every one must be grateful, even if it serves only as an introduction to an unexplored continent.

DR. HACK TUKE ON HYPNOTISM.

DR. HACK TUKE can hardly be said to have written a book on sleep-walking and hypnotism: it is a collection of papers which are full of repetition, and which are written in a style that is decidedly undress. But hypnotism is at present such an interesting subject, that any exact information about it is very welcome. The author's main object is to point out the resemblance between natural and induced somnambulism, which latter term he uses as another name for hypnotism, and to call attention especially to the former mode of aberrant mental action as an important aid to the study of mind. His own article on natural somnambulism, based on answers to a circular sent out six years ago, contains little that was not known before; but his examination into the mental condition of the hypnotic subject is of greater interest. He finds that consciousness may persist, or that it may pass rapidly or slowly into complete unconsciousness; the manifestations are not dependent upon its presence or absence. One subject, Mr. North.

Sleep-walking and hypnotism. By D. HACK TUKE, M.D., LL.D. London, *Churchill*, 1884. 6 + 119 p. 8°.

lecturer on physiology at Westminster hospital, says of himself at first, "I was not unconscious, but I seemed to exist in duplicate; my inner self appeared to be thoroughly alive to all that was going on, but made up its mind not to control or interfere with the acts of the outer self;" and later, "I knew perfectly well that I was playing the fool, i.e., that my outer self was doing so, the inner self looking on, too idle to interfere;" and later still, "Here I appear to have been absolutely unconscious for some moments." Another subject says, "Mr. Hansen told me that my hair was on fire. I touched my head, and saw that he was wrong. He then told me to put my head into cold water, directing me at the same time to a gas-burner. I felt it was not water: I felt the heat, but yet I could not refuse putting down my head and trying to wash it." Voluntary control over thought and action is suspended; reflex action of the cerebral cortex, in response to suggestions from without, comes into play; and, so long as consciousness is retained, the perception of this automatic cerebral action conveys the impression of a dual existence. Dr. Tuke's theory of the hypnotic state does not differ from that of Haidenhain: he holds that part of the cerebral cortex is exhausted by prolonged and monotonous excitation of certain sensory nerves, and that other parts, unexhausted, respond all the more acutely to stimulation. Whether hypnotism is injurious to the subject, or whether it has any therapeutic action, are questions that remain undecided. Mr. North found, after the third and last experiment tried upon him, that any exercise of close attention tended to bring on the same sensations as those which ushered in the hypnotic sleep.

From observations made upon patients at the Salpêtrière who were subject to hysteria major, Charcot and Richer were led to distinguish three distinct forms of hypnotism, — the cataleptic, the lethargic, and the somnambulistic. The last is the form which bears the closest resemblance to the ordinary mesmeric trance. In the cataleptic state, the limbs of the patient remain for a long time, and without effort, in any position in which they may be placed; in the lethargic the muscles are relaxed, but they contract strongly and definitely under gentle mechanical stimulation (*hyperexcitabilité neuromusculaire des hypnotiques*, first observed by Mr. Charcot in 1878). The lethargic subject may be made cataleptic by simply pulling open the eyelids and exposing the eyes to a bright light: closing the eyes is sufficient to put him back into the condition of lethargy. But, what is most remarkable, if one eye is kept open and the other shut, the singular phenomenon is witnessed of an individual divided into two parts by the median plane. One half of the body, that which corresponds to the closed eye, presents the muscular susceptibility characteristic of the lethargic state: the other, corresponding to the open eye, is in a condition of catalepsy. Mr. Charcot very properly says, that to suppose that an ignorant person, exposed for the first time to this experiment, should be able to invent such an extraordinary phenomenon as this, would be 'truly childish.' But, besides this presumption, he has an infallible method of detecting simulation. A very vigorous person, not hypnotized, can keep his arm extended as long as the cataleptic; but it is useless for him to try to pretend that it does not fatigue him. The operator has only to attach a pneumograph to his chest. The tracing which registers his respirations soon discloses great irregularity in their rhythm and their volume, and in this way his own muscles are forced to write down the evidence of his attempted deception.

The experiments of Charcot and Richer (*Archives de neurologie*) are conducted with a carefulness and ingenuity which should recommend them as models to the American society for psychical research.

INHERITANCE AMONG THE ANCIENT ARABS.

IN the study of Roman law the institution of agnation is discovered. By it descent and inheritance are in the male line. Among most of the tribes of North America, Morgan has shown that uterine descent and inheritance are established by law. In the study of these forms of descent among various peoples of the earth, Morgan came to the conclusion that uterine descent is everywhere the characteristic of primitive society; that it is primordial in savagery; and he attempted to account for the change from female to male descent.

There is yet another institution set forth in Roman law, called cognation, which is descent and inheritance in the male and female lines, and which is found more fully developed in the institutions of modern civilization.

Since Morgan's writings were published, the universality of uterine descent, or mother-right (*mutterrecht*), in primitive society, has been affirmed and denied by various writers; but

Das matriarchat (das mutterrecht) bei den alten Arabern. Von G. A. WILKEN. Leipzig, *Schulze*, 1884. 72 p. 8°.

altogether the evidence to the correctness of his views has steadily accumulated, until it is now almost overwhelming.

Mr. Wilken takes up this subject for the purpose of showing that mother-right once existed among the Semitic nations, especially among the ancient Arabs. The evidence adduced seems to fully warrant the conclusion. In connection with the main purpose of his paper, two subsidiary questions are discussed. The first relates to communal marriage; the second, to exogamy and endogamy.

With respect to communal marriage, the author is not clear in his conception of the nature of the institution. It is the marriage of a group of men (brothers) to a group of women (sisters). Sometimes the group of men is small; and a man may have no brothers, and still be entitled to a group of women for his wife. This is sometimes denominated 'hetarism,' and must be distinguished from polygamy, which is altogether a later institution. Sometimes the group of women may be small: in fact, a woman may have no sisters; in which case a number of men would have but one common wife. This is called 'polyandry.' Our author endeavors to find evidence, among the Arabs and other Semitic peoples, of communal marriage; but most of the evidence which he brings forward is not pertinent to the argument. The 'survival' of institutions analogous to 'atavism' in biology is a principle of great value to the student of early society, but it must be used with great care. Wilken describes the institution of mot'a, which is marriage for a limited and prescribed time, and other sexual practices among the nomadic tribes, and cites them as survivals of communal marriage from prehistoric times; but such practices, though they may be partially regulated and ameliorated by law, give no evidence of a more ancient institution, but rather show that in all times men have disregarded institutions, and broken laws, and have thus lapsed into immorality. Robbery still exists in the highest stages of civilized society, but furnishes no evidence that stealing was originally established by law, so as to constitute a prehistoric institution. Murder is still committed, but this does not permit us to infer that primitive mankind practised murder as a legalized institution. The various forms of hetarism practised in historic times among all peoples, like robbery, murder, and other crimes, testify to the fact that the passions of men are but imperfectly controlled by the regulations of society.

The author brings forward many instances and divers reasons for believing that exogamy formerly existed among the Arabs, and that it was finally changed into endogamy. On this subject the author seems to think that the evidence is contradictory, and he tries to draw an average conclusion therefrom. The contradictions, however, are not in the facts themselves, but in the author's misconception of the facts upon which theories of exogamy and endogamy have been based. His first great error is in using the term 'tribe' in different senses, as does McLennan and other writers of that school. They seem to think that the tribe is a group of people held together by the authority of some one person, — by a chief. Now, in fact, no tribe has yet been discovered organized on a plan so simple. All tribes are composed of two or more groups, each of which has an organization, and constitutes an integral part of the tribe. In many cases there are tribes with three, four, five, or even six units of organization of different orders. Sometimes the term 'tribe' is used to designate the unit of the highest order, — the whole body of the people; sometimes it is used to designate a clan or gens within the tribe; and again it is used to denote a sub-gens, or even a smaller group. The use of the term 'tribe,' or its synonyme in other languages, in this manner, has led to many errors, and apparently conflicting statements, in relation to the organization of early society. In all such tribes throughout the world, there is invariably some group of persons within which a man may not marry, and in respect to which he may be said to be exogamous; and yet he always has a right to marry somewhere within the larger group here denominated 'tribe:' hence, in relation to the tribe, he is endogamous. Every man, in all stages of society, is exogamous in relation to some group; that is, it is incest to marry within such group. In like manner, he is endogamous to some other or all other groups. Thus it is that every man, throughout savagery, barbarism, and civilization, is both exogamous and endogamous.

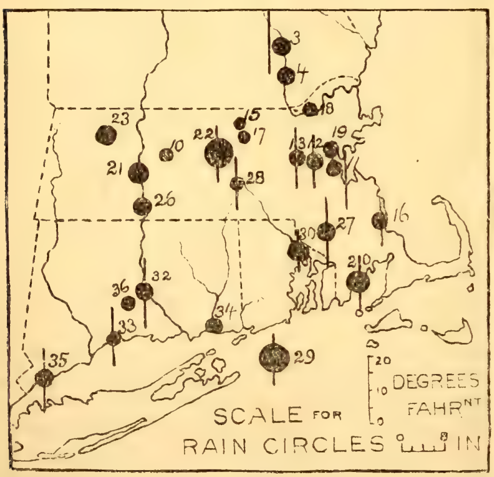
The author has the unfortunate practice of using the term 'matriarchy' (*matriarchat*) for the term 'uterine descent,' and 'patriarchy' (*patriarchat*) as a name for agnatic descent. The term 'patriarchy' has long been used for another purpose; that is, for the name of the organization of the social unit in which the father is the chief or ruler of his sons and sons' families, — a group of descendants, — and is in important particulars the owner of the common property. This patriarchal society is well described in the post-Noachian history

of the Bible, and the institution thus found has been taken as a type of that discovered in other parts of the world. Agnatic descent is one of the characteristics of patriarchy, but it may exist under states of society where the patriarchy does not exist; and to use the term 'patriarchy' as synonymous with agnation can but lead to confusion. Then, by analogy, he uses the term 'matriarchy' to signify descent in the female line, and the confusion is still worse; for, so far as we know, the mother is never the ruler of the clan, where uterine descent is established. In some cases the ruler is the uncle. The etymology of the term 'patriarchy,' and customary use, alike imply chieftaincy. The terms 'agnatic descent' and 'uterine descent' have no false implication, and properly express the facts.

J. W. POWELL.

NOTES AND NEWS.

THE New-England meteorological society, of which brief mention has been made in earlier numbers, has now advanced far enough to issue for November the first number of its monthly bulletin. This summarizes the results of thirty-six stations, mostly maintained by volunteer observers, comparing them with records of previous years in a tabular



RAINFALL AND RANGE OF TEMPERATURE IN SOUTHERN NEW ENGLAND FOR NOVEMBER, 1884.

numerical statement, and presenting data concerning precipitation, and range of temperature, in a sketch-map, the southern half of which is here reproduced. Measures of rain and melted snow are represented by black circles, while the mean daily range of temperature is indicated by vertical lines. Scales for the reading of both are added in the margin. The small size of the map gives it the appearance of being fairly well supplied with stations; but in reality they are as yet much too far apart to furnish satisfactory basis for studies of a detailed character. Even around Boston, where the greatest density of observation is found, there is need of additional observers before the society should consider its list of stations sufficiently extended; and elsewhere in New England the showing now made must be considered only the beginning of what should be accomplished a year or two hence. The bulletin states that all matters of observation should be addressed to Professor Winslow Upton, Providence, R.I.

— The Bureau of navigation of the navy department reports that a hundred and forty-five compasses with the four-needle card have been issued to ships during the past year, and that they have given general satisfaction, the behavior of the improved compasses used by the Greely relief expedition in high latitudes being especially commended. This expedition gathered considerable data concerning the variation of the compass in high latitudes; but, owing to its speedy return, none were obtained concerning the magnetic force and dip. The data concerning compass variations, collected by the department during the past year, are in course of preparation for publication. Professional paper No. 17, entitled the 'Magnetism of iron and steel ships,' is in press; and No. 18, on 'Deviations of the compass in U. S. naval vessels,' is nearly ready. Preparations have been made for a careful examination of the magnetic character of the new steel vessels, and a compass station is to be established in Narragansett Bay. The instruments for a compass testing-house are now in the possession of the bureau, and a building will be erected when the appropriation is made. In view of the probable necessity of compensating the compasses of these new vessels, a binnacle has been designed in the bureau for this purpose, and it will be placed in the Dolphin to be tested.

— Old residents of the California peninsula have noticed several varieties of birds near the seacoast that they have never before known to leave the mountains. This is supposed to indicate a severe winter, but the migration is more probably due to the prevailing scarcity of all kinds of seeds in the mountains this season.

— A complete outfit, consisting of Mangin's projectors, Gramme dynamos, Brotherhood engines and accessories, has been ordered for each of the new U. S. cruisers for use as search-lights. The dynamos and motors are to be mounted on one bed-plate, the engines being connected directly. The projectors will be furnished by Sautter, Lemonnier, & Co., of Paris, and the engines by Peter Brotherhood of London.

— The University of Pennsylvania has rented one of the tables at Dohrn's zoölogical station, so that the United States is again represented at the Naples laboratory.

— Under the title 'Micro-palaeophytologia formationis carboniferae,' Dr. P. F. Reinsch of Erlangen

proposes to issue a work in two volumes, in which are described and figured many microscopic forms resembling the spores of higher cryptogams, but which the writer considers to be independent unicellular organisms. They appear to have been very abundant in the carboniferous period, when higher cryptogams were the prevailing vegetable type. Dr. Reinsch offers to furnish to purchasers of his work duplicate specimens of some of the species described.

— A second edition of Dr. Lant Carpenter's 'Energy in nature' has just been published in England.

— According to *Nature*, the collections made by the polar traveller, Capt. Jacobsen, by order of the Berlin museum, on his American tour, are now on view at the Royal ethnographical museum at Berlin. That part of the collections which was obtained from Alaska territory consists of some four thousand objects, collected among various Eskimo tribes, and among the Ingalik Indians living on the Yukon River. Most of the objects in question closely resemble those dating from the stone age, consisting principally of stone, bone, horn, shell, or wood.

— The *Athenaeum* states that Consul O'Niell has this year accomplished two remarkable journeys in an unknown portion of East Africa. In the first he left the river Shire at Chironzi, and walked to Blantyre, leaving the Ma-Kalolo country on his left. In the second he walked to Guillimani, on the coast, from Blantyre, by a route leading south of Milanji, which will prove to be the nearest and most direct overland communication with the coast. He took twelve hundred observations for longitude, which will help to fix a trustworthy meridian in the interior, which has been much wanted. The account of these journeys will appear in the Proceedings of the Royal geographical society.

— The International Paris exhibition of manufactures and processes will be opened on July 23, 1885, and closed on Nov. 23. The exhibition will be held at the Palais de l'industrie, Champs Elysées, under the patronage of the minister of commerce and the minister of public works.

— From *Nature* we learn that the expedition of the German travellers, Dr. Clauss and Herr von den Steinen, who undertook to investigate the tributaries on the upper right bank of the Amazon and Xingu Rivers, starting from Paraguay and Cuyaba, have successfully accomplished this task, and safely arrived at Para at the end of October. The Brazilian government, and especially Senhor Batovi, the prefect of the province of Matto Grosso, have supported this scientific undertaking in a praiseworthy manner.

— At a meeting of the Anthropological institute of Great Britain, held on Nov. 11, Mr. Francis Galton described the object, method, and appliances of the late anthropometric laboratory at the International health exhibition, reserving the statistical results, which were not fully worked out, for another occasion. 9,344 persons passed through the laboratory, each of them being measured in seventeen distinct particulars for the sum of threepence, in a compartment only six feet wide and thirty-six feet long. So many applications have been made abroad and at home for duplicates of the instrumental outfit, that it was deemed advisable that any suggested improvements in it should be considered before it became established in use.

— Dr. Siemens of Berlin has offered the German government a piece of land in Charlottenberg worth $100,000, for the building of an Institute of mechanical and physical science. Preliminaries are already being arranged by Dr. Forster and Professor Helmholtz.

— Bulletin No. 6 of the U. S. geological survey is 'Elevations in the Dominion of Canada,' by J. W. Spencer, now at the university at Columbia, Mo., lately of King's college, Windsor, Nova Scotia. During his studies of Lake Ontario, Professor Spencer collected the altitudes along all the Canadian railroads constructed up to 1882; and these are now published in convenient form. The tables occupy thirty-three octavo pages, first arranged by railroads, followed by a selected alphabetical list. The altitudes are referred to mean ocean-level.

— Professor Paulitschke left Vienna on the 30th of November for eastern Africa. He proposes, in case access to Harar should be denied him, to explore some of the least-known districts of southern Abyssinia.

— *Petermann's mittheilungen* publishes the report of an excursion into the Somal country by J. Menges, one of the hunters employed by Carl Hagenbeck of Hamburg, the well-known dealer in wild animals. The explorer succeeded in reaching the plateau sixty miles to the south of Berbera, where its altitude is fifty-one hundred feet. He was disappointed in the ruins of stone houses promised him on the coast; such remains of buildings as he found being, to all appearance, due to the Galla, who formerly inhabited this country. A valuable map accompanies the report.

— Recent deaths: Dr. L. Fitzinger, formerly keeper of the Vienna museum, Sept. 22; Dr. Thomas Wright of Cheltenham, geologist, Nov. 17; Mr. R. A. Godwin-Austen, the geologist, Nov. 25, at his residence, Shalford House, Guilford, Eng.; Mr. Henninger, one of the editors of *Science el nature.*

— *Nature* states that Admiral von Schleinitz has resigned the presidency of the Berlin Gesellschaft für erdkunde, and has been replaced by Dr. W. Reiss. At the last meeting of this society it was stated that there are now four polar expeditions in preparation, of which one will start for the antarctic regions. The African traveller, Dr. Aurel Schulz, has started on a journey across Africa from east to west, by way of the Zambesi River and the Victoria Falls. Lieut. Schulz, the leader of the German-African expedition, reports from Cameroon that the joy of the German colonists there is most intense in consequence of recent political events.

— The course of lectures to graduate students at the Johns Hopkins university, which was opened on the 15th of November by President Gilman on academic degrees, will consist of the same number (twelve) as last year. Dr. G. Stanley Hall followed President Gilman with a lecture on student life. The other

lectures are by S. Newcomb, Mathematics and education; J. Rendel Harris, On the study of ancient manuscripts; W. K. Brooks, The zoölogical significance of education; M. Warren, Application of the historical method to the study of Latin; R. T. Ely, Educational value of political economy; M. Bloomfield, Method of comparative philology as pursued to-day; E. M. Hartwell, Physical training in American colleges; A. M. Elliott, Methods in the study of modern languages; W. E. Story, Methods of teaching arithmetic; T. Craig, Mathematical teaching in France.

— A statue of Claude Bernard is to be placed at the top of the grand staircase of the Collége de France. It will be the work of Guillaume, whose sketch plaster was erected on the site intended for the work when completed.

— Professional paper xiv. of the signal-service, entitled "Charts of relative storm frequency for a portion of the northern hemisphere," by John P. Finley, is just issued. It gives one annual and twelve monthly charts, which show the "distribution of tracks of centres of barometric minima over North America, the North Atlantic, and Europe," based on observations of the last twenty years. The annual chart, for example, explains at a glance why the region around our great lakes has so much more variable a climate than that of central Europe. With us, every rectangle bounded by two and a half degrees of latitude and longitude, from Minnesota to Maine, is visited by from twelve to fifteen storm-centres a year; France and central Germany have less than three on corresponding areas; even Great Britain and most of Norway have not more than six. The chief appreciation of the paper will be found, however, among navigators of the North Atlantic, as the principal object sought was the study of Atlantic storm-tracks, whose relative frequency is now shown graphically for the part of the ocean most commonly traversed. The execution of the maps by the signal-office lithographers is by no means satisfactory.

— The second annual convention of the Modern language association of America was held at Columbia college on the 29th and 30th of December. The modern pedagogic claims on instructors are fairly recognized by the titles of papers which were read, and of the subjects which came up for discussion, some of which were the following: How far may the latest scientific results be embodied in the text-book? by Prof. H. C. G. Brandt of Hamilton college; The modern language question, by Prof. A. M. Elliott of Johns Hopkins university; What place has Old English philology in our elementary schools? by Prof. Francis B. Gummere of New Bedford, Mass.; Would it be desirable to allow the substitution of one modern in place of one ancient language for admission to college? What amount of modern language study should be regarded as an equivalent for Greek? The extent to which purely scientific grammar should enter the instruction of ordinary college classes; A uniform pronunciation of Latin ought to be adopted in American colleges, and the Roman recommended.

— The January *Century* contains an article on the National museum from the pen of Mr. Ernest Ingersoll, admirably illustrated. Our readers will be very much interested in it. We wish that some modifications might have been made in the introductory sentences, which seem to us to do scant justice to the past. Mr. Ingersoll develops the grandeur of the scheme of the museum with lavish hand; and it would appear as if, were the plan to be carried out in detail, the District of Columbia would not be large enough to hold the museum.

— A special despatch to the Philadelphia *Times* from Washington, condemning the report of the National academy of sciences concerning the re-organization of the different scientific bureaus of the government, and endeavoring to set forth the certainty of Mr. Cleveland's antagonism to the government scientific surveys when he shall have become installed as president, has given occasion to an excellent reply in the *Times* for Dec. 21, from Mr. Charles A. Ashburner of the Geological survey of Pennsylvania, in which he says that the views expressed by Gov. Cleveland in his veto of the appropriations for the New-York state survey last year "do not necessarily indicate his position in regard to the appropriations which shall be made by congress during his term of office for the support of the geological survey. If he shall view this matter from a practical business stand-point, he will no doubt conclude, as others have who thoroughly understand the subject, that the results of the U. S. geological survey are of immediate practical importance, and that such government surveys in the past have had much to do with the great material advancement of the states. The importance of geology as an aid to the discovery, exploration, and exploitation of mineral deposits is acknowledged by intelligent persons; and there is scarcely a civilized government that does not recognize the fact by giving liberal appropriations in support of official geological surveys or by government aid to special geological investigation."

— Prof. Pliny E. Chase of Haverford college, Pennsylvania, who for several years past has been publishing in the Transactions of the American philosophical society the result of his, to say the least, recondite researches on the cosmic influences of harmonic waves, has lately prepared a small work, in two parts, on the 'Elements of meteorology' (Philadelphia, *Porter & Coates*, without date). Although one of the objects in view in its preparation was to provide a 'simple introductory text-book,' we cannot find that this has been realized. Even on the pages devoted to subjects that may be called orthodox, logical arrangement, precise definition, and sufficient explanation are wanting; while other pages, whose topics are, again to say the least, very heterodox, do not seem to us to furnish suitable material for the use of teachers in common schools. It is an unpleasant task to condemn a book, but justice to our readers requires that this one should be characterized as not representing the generally approved principles of meteorology of the present day.

SCIENCE.

FRIDAY, JANUARY 9, 1885.

COMMENT AND CRITICISM.

In another part of this number, Professor Hilgard takes exception to our views of the proper functions of agricultural experiment-stations, as stated some weeks ago. Yet "to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions," is precisely what we understand to be the object of experiment-stations. The question simply is, How shall such scientific aid be best afforded? Shall the experiment-station seek to reach an *empirical* solution of one problem after another as it may be presented to it, or shall it search into the elementary conditions of the most important of those problems, and thus endeavor to work out a *rational* solution? The view which we hold, and which seems to be indorsed by the paragraph we quoted in our comments of Dec. 5 from Director Sturtevant's report, is that it should do both; proportioning the amount of the two kinds of work according to the necessities of the particular case, but endeavoring to do as much work of the kind last mentioned as possible. We believe that work of the latter class should be held in the higher esteem, and that the constituency of the station should, if possible, be brought so to regard it, because its results are of vastly more permanent value. We do not hold that it should necessarily, or even usually, be placed first in the order of time, or that it should ever become the exclusive work of any public experiment-station.

Our suggested differentiation of agricultural experimentation would proceed upon a somewhat different basis, giving to the experiment-station proper the working-out of scientific results (empirical or rational, as the case may be), and to the experimental farm the verification of these results under the actual conditions of farm practice. We do not deny the advantages of uniting these two kinds of work in one institution when possible; but the men who combine the high scientific attainments and thorough acquaintance with practice necessary for the direction of both kinds of work are rare, and are likely to be rare for many years to come. We therefore hold, that, when such a man cannot be secured and kept as director, the disadvantages of segregation will be less than the disadvantages of having either the scientific experiments, or the verification in practice of their results, undertaken by incompetent hands. The separation would be in management, not necessarily in either time or space. There appears to us to be comparatively little danger that the work of American experiment-stations will be too rigidly scientific, and too far removed from the apprehension of farmers. There is a constant pressure upon a station for immediately useful results, and any station refusing reasonable conformity to it will not enjoy a long life. On the other hand, there is danger that this pressure for immediate and striking results may lead to a neglect of the scientific functions of such an institution.

The second series of the *Johns Hopkins university studies in historical and political science*, being the twelve numbers for 1884, is just completed; and Dr. Adams, its editor, may congratulate himself on his continued success in grouping together the monographic essays of the younger school of historical writers, who are arrayed under his supervision, and bow to one of Freeman's characteristic utterances, that 'history is past politics, and politics is present history.' These papers evince a new school of historico-political students, who carry antiquarianism beyond a dry assortment of agglutinated facts, and humanize it by connection with social development. The study of institutional and economic history,

in its direct connection with social progress, brings with it an urgent plea for recognition as conveying into the study of the past a good deal of that critical spirit and close observation which have made the laboratory and the closet twin arenas. In its reaction from the broad generalization, and the rotund expression which was so easily generated out of the now antiquated method, there is some danger, it is true, of the magnifying of minuteness beyond its inherent deserts; but it seems quite clear that the hither following upon the thither swing of the pendulum will bring a rest within a happy mean. The experiment is going on successfully, and every one interested in the orderly arranging of historical results will watch its further progress with interest.

THERE ARE sceptics among scientific men as well as among other professional men; and we have no desire to plead extenuating circumstances in favor of those so-called scientific men who claimed that steam-navigation would be a failure, or that ocean-telegraphy would be impossible. The believer in the truth of alleged psychical phenomena must encounter scepticism, and the newly formed psychical society must expect to receive many suggestions of doubtful expediency from both the learned and the unlearned. What no man knows, even the uneducated and untrained can pretend to know. The time may come when it will be not unusual to study 'veridical phantasms' by polarized light, and to observe their behavior in a magnetic field. What the result will be to physical science, it is difficult at present to perceive. It is not difficult, however, to conceive of a great influence upon imaginative literature. Why should not a devotee of psychical research add another scene to Hamlet, in which is displayed a psychical laboratory, with rows of bottles labelled 're-agents for ghostly odors,' 'tests for fragments of bogies,' and 'supersensual platform scales'? In the midst is Hamlet testing the kingly ghost. A favorable analysis would go far to explain the strength of Hamlet's convictions, which have so long been a deep study to psychologists.

Considering the renewed interest in archeological investigation, is it not surprising that there should not be an archeological psychical society, — a society, which, in place of exhuming relics of other civilizations, should endeavor to get closer to the primitive state of man by trying psychological investigations upon Eskimo, natives of central Africa, or the denizens of King Prester John's dominions? The complicated civilization of to-day is fast destroying these more or less original types. If the physicians of the time of Chedorlaomer had taken careful measures of the physical dimensions of the giants of those days, and had made experiments upon their appetites and their sense of color (which, of course, must have been enormous), we should have had accurate data in physiology and psychology, which could compare favorably with that we have in archeology.

An accurate study of a pure African's nervous organization, of his instincts, his sense of color, his hypnotic conditions, his reasoning powers in general, must be taken now, or the world will soon lose forever the opportunity. The steam-engine and the telephone will soon change the sable athletic rover of the underwoods to that higher state of civilization which, it is true, obliterates all those fine instincts we also had once in common with our animal ancestors, yet gives us in return nervous prostration, and the ability, it may be, to smell ghosts. Here is a great field of investigation, for the neglect of which our descendants will bitterly reproach us. If we are in search of a name, we might term the subject to which we desire to call the attention of the Psychical society, 'Darwinian psychology.' Is it not reasonable to suppose, that, by careful and systematic observations on young Eskimo and young Africans, we can gain a knowledge of still more primitive men, who, alas! are now only 'veridical phantasms'?

In physics, Fourier's theorem enables us, from certain measurements of temperature, to determine what will be the probable heat of the earth some time in the future. What we need in psychology is a psychical theorem, retrogressive in its character. The surroundings of man daily grow more varied; and his resemblances to his animal ancestors, it is claimed, are fast disappearing. Now is the time to sound a warning note. Our original psychical sources are disappearing. Instead of weighing a lusty African who will tip the scales at a hundred kilograms, we shall soon be reduced to weighing 'veridical phantasms' which we suppose must be below a fraction of a milligram. Back to the original sources, say we! This is the cry of all scholars, and psychists can form no exception to the general rule.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The functions of experiment-stations.

Referring to the editorial comments on this subject in the issue of *Science* of Dec. 5, I cannot omit to interpose a demurrer to what appears to me to be a somewhat narrow view of the proper functions of experiment-stations in this country, and one which, if understood to be the prevailing one, would quickly put an end to the popular demand for the establishment of such stations, especially in the newer states.

If it is not one of the essential and primary objects of agricultural experiment-stations to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions and factors in a new country, in order to afford them relief from the slow tentative process of blind experimenting by which the solution of practical questions is commonly approached, then, indeed, the *raison d'être* of such establishments will be seriously questioned in all but the older states, where the *otium cum dignitate* of purely scientific investigations can be indulged in without leaving undone things that ought first to be done.

If the experiment-stations do not do this work for the farmer, who is to do it? It is not certainly the function of the agricultural colleges as such, although in very many cases their greatest present usefulness assuredly lies in that direction; since their direct influence through the few students who hasten through a superficial course in their halls will long remain insensible, unless supplemented by such practical demonstration of the usefulness of agricultural science as the experiment-station work can afford. From both the practical and the educational point of view, then, those functions to which the article in question allots a second place, should, in my view, be placed first.

Again: it is said that to unite the two functions of an experiment-station — the scientific and the practical — in one institution and under one management is of doubtful propriety. So far from admitting this, I hold that nowhere can scientific investigation be more fruitful than where, in this direct connection with practice, it is brought face to face with new conditions, and therefore with new phases and aspects of old problems. I think it would be a grave mistake to segregate the two branches of the work, whether in space or time, and most especially to intrust the solution of practical problems to persons of inferior qualifications, as is too commonly done, to the detriment of the cause of science, and to the disgust of those engaged in pushing it in the face of the difficulties it naturally encounters in a new country. There is a limit to the usefulness of differentiation, when each of the segregated branches is thereby trimmed down to narrowness, and want of proper co-ordination with the other. In our widely varied domain, each location affords peculiar advantages for the prosecution of some branch of both pure and applied agricultural science; and those in charge of the several stations should know, or carefully consider, in which direction their greatest usefulness (in the widest sense of the word) lies.

No one narrow definition of the proper duties and functions of agricultural experiment-stations can apply to all cases alike. Each station will have to adapt its mode and scope of operations to the surrounding circumstances; and the good judgment exercised in determining these points will in a great measure determine also the scientific as well as the practical usefulness of such an establishment. With any thing like an adequate endowment, the two branches are not only compatible, but will fertilize each other, as does the combination of investigation and instruction in the case of teachers. The abstract investigator will rarely shape and express his ideas as clearly as the one who is habitually compelled to put them into the proper form for the understanding of others; and the same is measurably true of the experiment-stations, in which scientific work, and that intended for the direct instruction of the contemporary population, should go hand in hand. It does so even in Europe, where the practical questions needing determination are much fewer and less intricate; and, if it be contended that a different policy should be adopted in this country, the *onus* of showing the reasons therefor certainly devolves upon the advocates of the new doctrine. E. W. Hilgard.

University of California.

The most economical size of electric-lighting conductors.

In *Science*, No. 97, p. 524, Professor Carhart points out an oversight of mine (No. 94, p. 477) in leaving out the cost of waste heat in the conductors as a part of the economy in the Edison three-wire system, and also a mistake in estimating its amount; in both of which I am glad to be corrected. But Professor Carhart has not, I think, quite reached the most economical result, for the reason that we have the interest on n conductors, but heat developed in *only two* of them; and, as it seems worth while to develop the complete solution for this interesting system, I further submit the following: —

Suppose the size of conductors in the two-wire system to be such that the interest on their cost equals that of the heat-energy developed in them (C^2R, using Professor Carhart's nomenclature), which, for simplicity, we will take equal to unity. The general

expressions for the various constants (in terms of those of the two-wire system), when the same plant of lamps is divided up (with n conductors, each of whose cross-sections is k times that of one of the first) into $n-1$ equally-balanced circuits, with $n-1$ dynamos in series, as in the Edison system figured on p. 477, vol. iv. (the same energy being developed in the lamps as at first), will then be: —

$(n-1)^2 . r =$ the resistance of the lamps.

$\frac{R}{k} =$ the resistance of the two outside conductors.

$\frac{C}{n-1} =$ the current in the same.

$\frac{CR}{(n-1)^2 . k} + Cr = E_{n-1} =$ difference of potential at terminals of each of the $n-1$ dynamos.

$\frac{C^2R}{(n-1)^2 . k} =$ heat-energy wasted in two outside conductors.

$\frac{C^2}{(n-1)^2} . (n-1)^2 . r = C^2 r =$ energy developed in the lamps.

$\frac{n}{2} . k . C^2R = \frac{n}{2} . k =$ interest on cost of n conductors.

The energy consumed in the lamps (C^2r) is the same as at first, as shown by Professor Carhart, and, being constant for the plant of lamps, need not be further considered. The total running-expense, then, *due to conductors* (including interest on their cost), is

$$\frac{n}{2} . k + \frac{1}{(n-1)^2 . k}$$

in terms of C^2R. This should be a minimum. Its first differential coefficient with reference to k, placed equal to zero, gives

$$k = \frac{1}{n-1}\sqrt{\frac{2}{n}}$$

as the most economical section. This gives, for the minimum value of the total running-expense,

$$\frac{1}{n-1}\sqrt{\frac{n}{2}} + \frac{1}{n-1}\sqrt{\frac{n}{2}} = \frac{1}{n-1}\sqrt{2n},$$

the interest and heating-cost being equal, as they should. The same value of k gives

$$E_{n-1} = \frac{1}{n-1}\sqrt{\frac{n}{2}} . CR + Cr$$

as the corresponding difference of potential at the terminals of each of the $n-1$ dynamos.

Substituting now in these different expressions, and also in corresponding ones for the Edison system and for Professor Carhart's plan, values of n from 2 to 6, we have the various data given in the following table.

No. of conductors.	Cross-section of each.	Difference of potential at terminals of each dynamo.	Interest on conductors.	Heat-waste in conductors.	Running-expense of conductors.
		EDISON'S SYSTEM.			
n.	$\frac{1}{(n-1)^2}$	$\frac{(n-1)^2}{(n-1)(n-1)} CR + Cr.$	$\frac{n}{2(n-1)^2}.$	$\frac{(n-1)^2}{(n-1)^2}.$	$\frac{n}{2(n-1)^2}+1$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.250	1.000 " "	0.375	1.000	1.375
4	0.111	1.000 " "	0.222	1.000	1.222
5	0.062	1.000 " "	0.156	1.000	1.156
6	0.040	1.000 " "	0.120	1.000	1.120
		PROFESSOR CARHART'S PLAN.			
n.	$\frac{1}{n-1}.$	$\frac{1}{n-1} . CR + Cr.$	$\frac{n}{2(n-1)}.$	$\frac{1}{n-1}.$	$\frac{n+2}{2(n-1)}.$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.500	0.500 " "	0.750	0.500	1.250
4	0.333	0.333 " "	0.667	0.333	1.000
5	0.250	0.250 " "	0.625	0.250	0.875
6	0.200	0.200 " "	0.600	0.200	0.800
		THE MOST ECONOMICAL PLAN.			
n.	$\frac{1}{n-1} . \sqrt{\frac{2}{n}}$	$\frac{1}{n-1} . \sqrt{\frac{n}{2}} CR + Cr.$	$\frac{1}{n-1} . \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} . \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} . \sqrt{2n}$
2	1.000	1.000 $CR + Cr$	1.000	1.000	2.000
3	0.408	0.612 " "	0.612	0.612	1.225
4	0.236	0.471 " "	0.471	0.471	0.943
5	0.158	0.395 " "	0.395	0.395	0.791
6	0.115	0.346 " "	0.346	0.346	0.693

Some very interesting comparisons of relative advantages might be noted, did space permit. The most important is the rapid increase in the ratio of heat-energy to capacity of conductor in the Edison system, which might make it necessary to lay the wires so as to admit of pretty free radiation of heat.

This question of temperature of electric-lighting conductors promises to protrude itself the more they are laid underground. The desideratum for an insulating covering would seem to be a non-conductor of electricity and good conductor of heat, — apparently inconsistent qualities. Perhaps the eventual solution will be in bare or loosely covered wires on highly insulated points of support, thus admitting of free radiation of heat, like aerial lines. H. M. PAUL.

Washington, Dec. 15.

Sun-spots.

Mr. Todd, in a recent number of *Science*, speaks of Sept. 23, 1883, as the last day of that year on which

the sun was free from spots. I find that I observed the sun, for the purpose of mapping its spots, Dec. 5, at eight A. M., Washington (Penn.) local time, and it seemed to be entirely clear. The instrument used was a four-inch refractor. Thinking I might have overlooked some small ones, I observed it again with an eight-inch refractor at half-past one, power of a hundred and fifty, and did not see any spots. The contrast between the sun's face, Dec. 5, 1883, and Nov. 5, 1883, is very marked. I find I mapped seven groups on Nov. 5, 1883, one of them having eight well-developed spots. D. J. MCADAM.

Washington, Penn., Dec. 19.

On the care of entomological museums.

The editorial comments on this subject in *Science* for Dec. 19 are certainly very pertinent. For a long time I have been at work on the micro-lepidoptera of North America, until now I have by far the largest collection of the Pyralidae, Tineidae, and Pterophoridae of this country, and a collection of the Tortricidae of the world, fuller and more complete, probably, than any other in existence. My work has hitherto been, in a great measure, to get the insects authentically named by a careful comparison with the original types, in order that the collection, already so large, should prove in some sense an authoritative standard for comparison. This work has, of course, given me an opportunity of observing the condition of the types of North-American micro-lepidoptera in the collections both of this country and Europe, and the care which they have received.

In some American museums the insects are looked after by men who have to gain their livelihood in some vocation remote from the museum. The authorities of other museums have the impression that they have made adequate provisions for the preservation of their insect-collection when it is put under the oversight of an assistant, although he may have no knowledge whatever of such objects. It is not surprising that so many types are represented in these museums by a labelled pin only.

One great trouble is, that many museum officials have very little appreciation of the vast amount of labor, care, skill, and knowledge required to bring together, properly arrange, preserve, and make accessible to those who are competent, and desire to study any one or more of the insects in it, a large and varied collection. One director told me that it did not seem profitable to pay a man two thousand dollars to watch a thousand dollars' worth of insects; and yet he was not at liberty to dispose of them, so they must go to destruction.

At present I believe the museum at Cambridge is the only one in this country which gives assurance that a competent curator of entomology will always be employed; yet I think it is not provided with means to purchase collections of insects. The National museum has appointed an honorary curator; but it might as well be without any as to have one whose entire time is occupied elsewhere, for who would think of donating valuable and perishable types to a museum thus officered!

As matters now stand, it is better for those who are able to dispose of their collections without a consideration to allow them to go to the Museum of comparative zoölogy; but, if they are not able to give them, they should go into the hands of private individuals who are working on that particular class of insects. It is better for them to be sold to the European museums, where they will be preserved, than for them to go to destruction in a museum of this country. C. H. FERNALD.

State college, Orono, Me.

Your remarks, p. 540, in regard to the preservation of insect-collections are eminently proper and to the point, with the exception of the closing assertion, which is not justified. It is true that the curatorship of insects in the National museum is at present honorary, and that there is no paid assistant; but it is equally true, that, since my charge of that department, all collections and every single specimen received at the museum have been properly cared for; so that where, up to three years ago, nothing of the many valuable collections brought to the museum remained, there is now the nucleus of a collection; and so long as I am curator of the department, honorary merely though the position may be, no material shall go uncared for. Feeling that a beginning toward a national collection had to be made, and that the museum was the proper place for it, I have thus far given my time to this object in the belief that proper financial provision will be forthcoming for such conduct of the department as will guarantee both the preservation and the future care of collections. When such provision is made, my own private collection, and others that I know of, will be donated to the institution. Until then much valuable entomological material will naturally be lost to the capital.
C. V. RILEY.

[We neither expressed nor intended any slur whatever upon the present honorary curator of the insect-collections of the National museum. As any one can see, our remarks applied to the perpetual care of valuable collections. If they are not insured perpetual care, the less of them that go there the better. And so we repeat, that "the appointment of an honorary curator is worse than useless. It only deceives those who know no better, into the supposition that collections sent to the museum are insured proper care. They are not." We regret if the present honorary curator feels hurt by this 'closing assertion;' but it is the only logical outcome from our previous remarks, which he characterizes 'eminently proper and to the point.' — ED.]

THE CHEMICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.

IN 1876, the year in which the Johns Hopkins university was opened to students, a small chemical laboratory was built. It was large enough to accommodate about forty working students, and was well equipped with the necessary conveniences for chemical work, from the most elementary to the most advanced. In the course of a few years, temporary desks were put up wherever an available corner could be found, and finally it became evident that a larger building must be erected. Accordingly, the trustees voted to enlarge the old laboratory so as to make room for a hundred students. The work has recently been completed; and,

as the new laboratory is the result of a great deal of thought, it is believed that a brief description of it would be of interest and value to the readers of *Science*.

The laboratory adjoins the biological laboratory lately described in these pages. A space of forty feet in width separates the two buildings, securing ample light for both. The north end presents a frontage of fifty-five feet on the street. A view of the street end is given in fig. 1. It extends back from the street about one hundred feet, the back part being eleven feet narrower than the front. It is built of the finest pressed bricks, and ornamented with a bluish sandstone, and presents a handsome, substantial appearance. On the east is one of the university buildings, containing the general library. The south end receives light unobstructedly, the nearest building being somewhat more than one hundred feet distant. The intervening space is the property of the city, and will not be occupied by buildings. Thus from all four directions the laboratory is well lighted, and there is practically no danger that the light will be interfered with.

Entering from the street, we find ourselves in the corridor of the first floor. On the left is the gas-analysis room, so situated that the direct light of the sun cannot enter it. It is fully equipped for all kinds of analytical work with gases. The apparatus of Bunsen, and the more rapid though less accurate apparatus of Hempel, are always ready for use. The floor, the joints of which are laid in white lead, is made of carefully selected strips, and thoroughly oiled and waxed. Further, it slants slightly from all points towards one corner of the room, where there is a box at a lower level, containing a bottle arranged so as to catch any mercury that may be spilled. Next on the left there is the photometric room. The walls of this room are black, and the windows are pro-

FIG. 1.—NORTH END OF THE JOHNS HOPKINS CHEMICAL LABORATORY, FACING THE STREET.

vided with black Venetian blinds, which, when drawn, exclude all light. The polariscope, spectroscope, goniometer, photometer, and photographic apparatus are used here.

On the right, next in order, is the first of the three large working-rooms for students, known as laboratory A. Its dimensions are thirty by thirty-two feet. The work of those who are in the earliest stages of their course is carried on here. Forty students can be accommodated in this room at one time without inconvenience. Adjoining it is a large storeroom, in which the chemicals are kept, and the solutions for the reagent-bottles prepared.

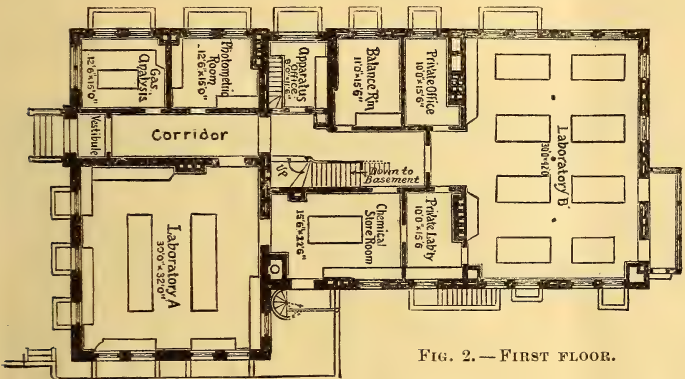


FIG. 2.—FIRST FLOOR.

On the opposite side of the hall are the apparatus-office and a balance-room. The office is connected by a stairway with the store-rooms for apparatus, which are in the basement. All necessary apparatus is loaned to students who sign receipts for whatever they may take; and the cost price is charged for any thing which may not be returned in good condition.

Passing on, we enter laboratory B, which was the main working-room of the old laboratory. It measures thirty by forty-two feet, and has places for thirty students. Those who work in this room have had some preliminary training. They are here engaged in complicated qualitative mineral analyses, preparations, and quantitative analyses. The office and private laboratory of Associate-Professor Morse adjoin this room, and open into it.

The arrangements for sulphuretted hydrogen deserve special mention. As is well known, this valuable gas is the chief source of discomfort in chemical laboratories; and chemists will, perhaps, wonder and doubt when it is stated, that, in the laboratory under consideration, its familiar odor is practically unknown. This desirable result is reached by providing for it, not a separate room, as is customary, but a separate, thoroughly ventilated building, immediately adjoining laboratory B, but completely isolated from it. It is provided with a high chimney, and means are taken which not only ought to, but actually do, secure a constant upward draught. It contains a large gas-generator, which furnishes sulphuretted hydrogen, and which is in charge of the janitor, who is required to see that it is kept in order. All work with noxious gases must be carried on in the 'stink-room,' under penalty of the law. The experience of the past year has been such as to lead the writer strongly to advise all who have any thing to do with building chemical laboratories to see that they are similarly provided.

Having thus taken a hasty glance at the first floor, we may pass to the second. Here we find the main lecture-hall, with a large preparation-room opening into it. Over the lecture-table, extending nearly the entire width of the room, is a large hood of galvanized, corrugated iron. This is connected with a ventilating-flue, the opening of which is about fifteen feet long by three feet wide, extending upward through the roof. A row of gas-jets may be lighted at the lower end of this flue, thus securing a remarkably efficient ventilation. On the table there is also a closed hood, and a pipe with down draught.

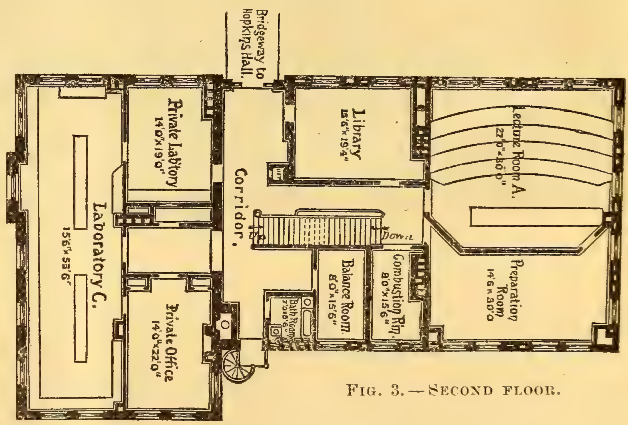


FIG. 3.—SECOND FLOOR.

The library is unusually well supplied. It

contains full sets of nearly all the important chemical journals; and all the current journals are received in exchange for the *American chemical journal*, which is published under the auspices of the Johns Hopkins university. Books may be taken out of the library by any one working in the laboratory. He is only required to sign a receipt, and leave it with one of the assistants, who acts as librarian. Notwithstanding the freedom allowed in the use of the books, only one insignificant volume has been lost during the past eight years.

FIG. 4.—RESEARCH-ROOM IN THE JOHNS HOPKINS CHEMICAL LABORATORY.

Passing to the north end of this floor, we enter laboratory C, or the research-room. This is well lighted by windows on the north side, as well as on the east and west. It measures fifty-three and a half by fifteen and a half feet. It is perhaps the handsomest room in the building. The walls are of cream-colored glazed bricks, the color of which is relieved here and there by a row of delicate blue. The windows are large. The table-tops are of black-walnut, the lower parts of light wood. The most advanced work, including the researches, is carried on here. Most of the students who occupy the places are looking forward to taking the degree of doctor of philosophy within a year or two. The instruction is under the immediate supervision of the director of the laboratory, Professor Remsen, whose private laboratory and office adjoin the room.

On the third floor the principal room is intended for a chemical and mineralogical cabinet. It is furnished with cases, like some of those used in the National museum at Washington. The object of the collection which has been begun is not show, but simply instruction. A curator has recently been put in charge, and it is hoped that before a great while the results of his care will be apparent. The idea which is to guide him is this: to get together good specimens of all available substances which are strictly chemical, then such minerals as illustrate the forms in which the different elements occur, and, finally, specimens

which illustrate the most important applications of chemistry to the arts. The first two classes are already well represented, and a fair beginning has been made on the third.

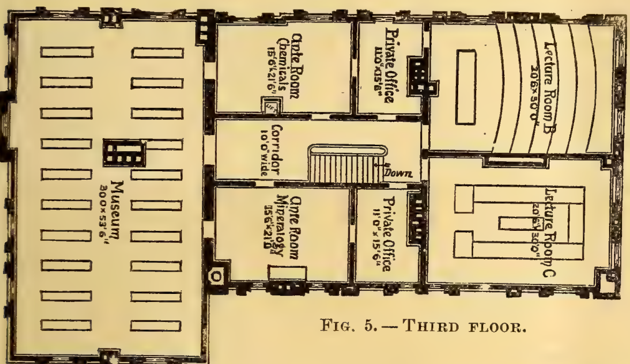


FIG. 5.—THIRD FLOOR.

It is, however, in connection with the third class that the chief additions will be made for some time to come.

On the third floor, in addition to the cabinet, there are two lecture-rooms,—one for chemistry, and the other for mineralogy,—besides two small laboratories for the examination of minerals, and the preparation of specimens for the museum.

There remains only the basement, which is well lighted, and really amounts to an additional story. It is, of course, largely taken up by storerooms and the heating-apparatus; but there are, in addition, two convenient large rooms, which have been fitted up for furnace-operations. In one of these are, among others, two smelting-furnaces of the extremely convenient form in use in the assay-laboratories connected with the U. S. mints. All the necessary conveniences for assaying ores have been secured, and it is intended that all students of pure chemistry shall at least know what assaying is. It is not proposed to go into the teaching of applied chemistry in any narrow sense, but rather "to afford the thoroughly-trained chemist an opportunity to familiarize himself with some of the more important applications of his science."

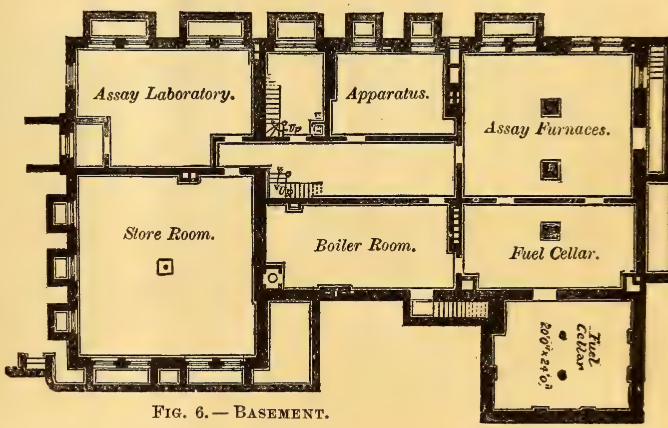


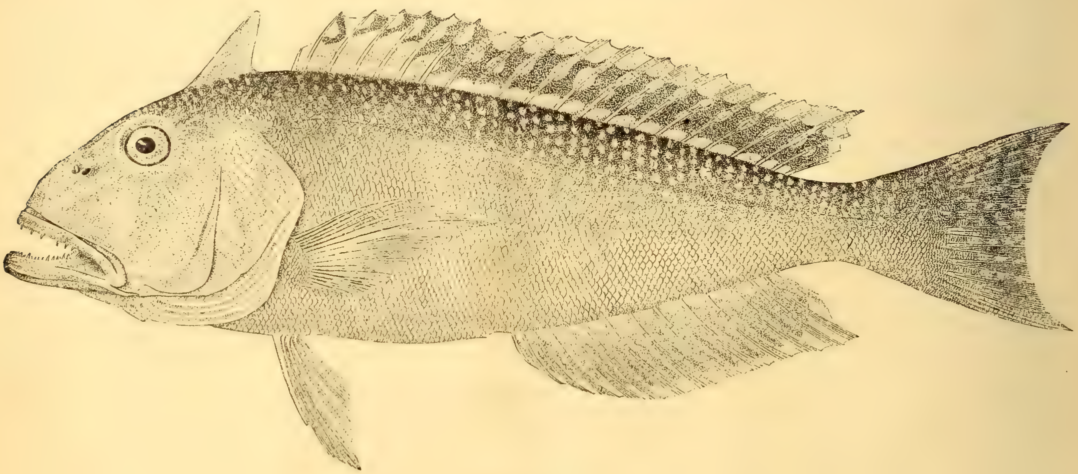
FIG. 6.—BASEMENT.

In conclusion, it should be stated distinctly that the laboratory not only works well on paper, like some of the chemical reactions which students are wont to originate, but, as a matter of fact, it has been found to be extremely convenient and practical. The flues draw in the right direction; the desks are large enough, more space being allowed each individual than in any laboratory known to the writer; the light is good; the water and gas supplies are ample: in short, no serious complaint has been made against the working of any essential feature, though a large number of students have been constantly engaged in it during the year. It is believed that in its present condition it affords facilities for every kind of chemical work. 'Conveniences' have not been unduly multiplied, as the director's experience has led him to the belief that it is possible to make a laboratory so extremely convenient that it is difficult to work in it. It may safely be asserted that all really valuable forms of apparatus or arrangements for special operations have been taken into account, and embodied in the building.

THE TILE-FISH.

IN the spring of 1879 a Gloucester fishing-schooner, accidentally fishing on the Gulf-Stream slope south of New England, found in abundance a fish which later proved to be new, and was described under the name of Lopholatilus chamaelionticeps, but which the fishermen named tile-fish. The fish-commission later found that it possessed excellent edible qualities; and the prospect of thus adding a new fish to our east-coast food-fishes created a stir at the time. So bright were the prospects, that a fishing-vessel was even being fitted out

for the purpose of catching this new fish, when, in the early spring of 1882, reports were brought in by vessels that dead tile-fishes were seen floating in immense numbers over areas of many square miles. These dead or nearly dead fishes were floating, belly upward, all the way from off Cape Hatteras to Nantucket, and in such numbers that there were in one case estimated to be fifty in a square rod. As they weighed from five to fifty pounds, even allowing for exaggeration, the sight must have been strange. They were examined, and found to be perfectly healthy, and some were eaten. All were not dead, but some seemed to be benumbed; and, when placed in the sun on deck, they revived sufficiently to move the muscles slightly. There were some other fishes among them in a similar condition; but, as none were saved, the species cannot be identified. This great abundance of paralyzed fishes on the surface, without any apparent reason, attracted much attention, and many causes were ascribed to explain the phenomenon. The fish-commission itself made inquiries; and the following startling statistics concerning the number of dead fishes are taken from Capt. Collins's official report. They covered 4,250 square miles; and, if one-twentieth of the number recorded by the man who saw the most be taken as an average number for the area, we have a total of 1,438,720,000 fishes. Even if we allow only one fish where the observer reported 400, we still have an astounding total of 71,936,000 fishes. Taking ten pounds to be the average weight, we find that there were 719,360,000 pounds of dead fish on the surface. The extreme abundance of these fishes was never imagined before their destruction. This destruction is not without parallel; for in certain bays on the coast of Labrador, when icebergs have grounded, cod have been killed in great numbers by the sudden decrease of temperature, and their bodies washed ashore. In Texas, during the Mexican war, after a very cold night, enough fishes were washed on the beaches in a benumbed condition to furnish food for Gen. Taylor's whole army. Other cases are recorded where volcanic action has caused similar destruction. Of the theories suggested to explain the destruction, all were discarded but that of cold water. Volcanic action could not be used to explain it, because there was no disturbance; and disease would not account for the phenomenon, because all the fishes were perfectly healthy.



THE TILE-FISH.[1]

The tile-fish is a warm-water fish, and belongs to a family which is peculiarly a tropical group. The part of the ocean which these fishes inhabit is a portion of the rapidly sloping Gulf Stream slope. A narrow belt in this region, having a depth of from seventy to a hundred and fifty fathoms, is so influenced by the Gulf Stream as to have a nearly uniform temperature of about 50° F. the year round. On either side of this belt is one of much colder water. The inner shallow shore-water often descends in winter below 32° F., and beyond to the great ocean-depths the temperature gradually descends. This belt, being so much warmer and more uniform in tempera-

[1] Reproduced from a drawing loaned by the U. S. fish-commission, as were the cuts on pp. 337, 338, vol. iv.

ture, is, as a natural consequence, inhabited by a different fauna; in fact, by a tropical deep-sea fauna, an extension of that of the West Indies. Not only the tile-fish, but certain crustaceans, are examples of these. Naturally they would be sensitive to cold. During the spring of 1882, violent and long-continued easterly and northerly winds prevailed, and numerous icebergs stranded on the George's Banks just north of the belt. We have every reason for believing that these winds carried the inshore waters, which were naturally cold, but whose temperature had been lowered by the stranded bergs, across the border-line and into the warm area. If this were the case, such delicate animals as the tile-fish could not possibly stand the sudden change which their more hardy neighbors could easily live through. So it was that the tile-fish and a few other species were exterminated from these grounds. Although the fish-commission has organized many extensive expeditions for the sole purpose of searching after the tile-fish, not a single specimen has since been found, either of the tile-fish or the other species. Whether or not they still exist in waters more southern is an open question; but we understand that Professor Verrill believes they will be found there. At any rate, it is certain that they are entirely absent from their former haunts, and that, if they do exist elsewhere, many years must elapse ere they inhabit this bank again in abundance. Such sudden changes as these, and local extinction of several species by such simple means, cannot help throwing much light upon paleontological geology.

RALPH S. TARR.

COMETS AND ASTEROIDS OF 1884.

WHILE the year 1884 has brought no comets of remarkable brilliancy or popular interest, compared with the comets of 1881 or 1882, nearly all the comets of the year will claim more than ordinary attention at the hands of astronomers, on account of the interest which attaches to the investigation of their orbits. Of the five comets seen, four have been periodic.

The first comet which was discovered in 1884 belongs properly with the comets of the preceding year, as it passed perihelion on Dec. 25, 1883. It was discovered, however, on Jan. 7, 1884, by Ross, an amateur observer, at Elsternwick, near Melbourne, Australia, — "a faint nebulous object, with an ill-defined central condensation, and a small, tail-like projection." It was not visible in the northern hemisphere, and was under observation for only about a month. The tail was one and a half degrees long on Jan. 18, 1884.

The first comet of 1884, in order of perihelion passage, was that discovered, or rather re-discovered, by Brooks, at Phelps, N.Y., on Sept. 1, 1883. It has been commonly known as the Pons-Brooks comet, or Pons comet of 1812, having been originally discovered by Pons at Marseilles in that year. An account of this comet has already appeared in *Science* (iii. 67).

The second comet, in both order of perihelion passage and of discovery, was that found by E. E. Barnard of Nashville, Tenn., on July 16, 1884. At the time of discovery it was a nebulous object, slightly condensed near the centre, and tolerably bright. It was found to move in an elliptical orbit with a period of about five and a half years, the elements bearing a very close resemblance to those of DeVico's comet (1844, i.). The comets do not, however, appear to be identical. The nearest approach to the sun was on Aug. 16.

The third comet of 1884 was discovered on Sept. 17, by Wolf, a student at Heidelberg, and is still under observation. In its physical appearance, the comet has changed very little since discovery. As far as I know, it has not at any time been visible to the naked eye, nor has it shown any indications of a tail. When examined on Nov. 13, with the nine-inch equatorial at the Naval observatory, under a magnifying-power of one hundred and two diameters, it presented the appearance of a 'slightly oval, nebulous object.' Near the centre of the nebula was a bright disk nearly circular, and in the centre of this disk the stellar nucleus. The line of demarcation between the disk and the surrounding nebula was, of course, extremely uncertain; but measures made with the filar micrometer gave, roughly, a diameter of 1′ 52″ for the outer nebula, and a diameter of 18″ for the central disk. Using the distances given in Krueger's ephemeris, these measures would represent distances of forty-seven thousand and seventy-five hundred miles respectively. By far the most interesting feature of the comet is its orbit. Krueger has assigned a period of about six and seventh-tenths years, but there is no evidence of any previous appearance. He remarks that at the returns in 1871 and 1878 it was unfavorably situated. In 1891 and 1864 its situation is favorable, if we can suppose that it follows the same path as at present. Krueger points out, furthermore, that in the early part of 1875 the comet must have suffered considerable perturbation by Jupiter, and before that time it may have been following an entirely different orbit. Perihelion was passed on Sept. 26.

Encke's comet, the most interesting short-period comet, has just been reported by Professor Young. It is extremely faint, but will grow somewhat brighter. It will not reach perihelion till March, 1885.

To complete the list, we should mention a 'suspected' comet to which some interest is attached. A faint, round, nebulous object was found by Spitaler with the twenty-seven inch refractor of the Vienna observatory, while searching for comet 1858, iii., on the morning of May 26, 1884. Unfavorable weather prevented a re-examination of this place till June 17 and 18, when the object could no longer be seen, nor

could it be found afterwards near its predicted place. It is still doubtful whether this was the expected comet.

During the year, ten new asteroids or minor planets have been discovered, making the total number now known two hundred and forty-five. The new-comers are as follows: (236) Honoria, discovered by Dr. J. Palisa, at Vienna, April 26; (237) Hypatia, by Palisa, June 27; (238) by Knorre, at Berlin, July 1; (239) by Palisa, Aug. 18; (240) Vanadis, by Borelly, at Marseilles, Aug. 27; (241) Germania, by Dr. R. Luther, at Düsseldorf, Sept. 12; (242) Kriemhild, by Palisa, Sept. 22; (243) by Palisa, Sept. 29; (244) by Palisa, Oct. 14; (245) by Palisa, Oct. 27 (at first taken for Andromache). W. C. Winlock.

FURTHER NOTES ON BOGOSLOFF ISLAND.

An examination of the official report of Capt. Healy, Lieut. Cantwell, and Dr. Yemans, of the U. S. revenue-cutter Corwin, and of the drawings and photographs by which it is accompanied, affords a few further notes of interest in regard to this remarkable island. It may be recalled that the new peak was first seen, so far as now known, by Capt. Anderson of the Matthew Turner, Sept. 27, 1883, and that therefore the application to it of the name of Capt. Hague, on the ground that he was the discoverer, as suggested by Lieut. Stoney, is erroneous. We prefer to retain the prior name of Grewingk, who first collected and discussed all the existing data in relation to the island and its changes.

In regard to the Bogosloff peak, the new observations determine that it contains a dike or central longitudinal wall of laminated rock, probably volcanic, of which Ship Rock may be an outlying spur. The top and ends of Bogosloff are entirely, and the sides partly, uncovered by the disintegration of a very friable rock of different character from the core. The high sharp pinnacles observed in 1873 appear to have been destroyed by the commotions attending the upheaval of Grewingk. The highest (east) point is now about three hundred and thirty-four feet, the centre two hundred and ninety feet, and the west part three hundred and twenty-four feet in height. These differ slightly from Stoney's figures, and considerably from previous measurements. Allowing for all the probable diminution in height, due to various causes, we are convinced that a large part of the discrepancy is due to error in earlier measurements, including our own; since the length of the peak, which cannot have changed much, is only about a thousand feet. The earlier estimates of the height of Grewingk were about double its real height. The tendency is always toward overestimating a height when there is nothing adjacent for comparison, and accurate measurements from on shipboard are extremely difficult. The south spit of Bogosloff has certainly increased greatly in length since recent disturbances, and now measures about eighteen hundred feet, when previously it did not exceed one-third the length of Bogosloff. The north end of Bogosloff rises nearly vertically with a sort of cave at its base. The shores of both peaks are fringed with large water-worn bowlders of hard rock. The axis of the old peak and spit is in a south-east by east direction. There was not the slightest sign of recent vulcanism about it; and the crags were the haunt of myriads of birds, but too crumbling to scale. There are no birds on the new peak, and those accidentally entering its vapors are quickly suffocated. Ship Rock rises eighty-seven feet, and has been elevated about twenty feet above its old level, judging by the barnacles still clinging to its sides. The apex has crumbled a little, and is less squarely cut than formerly.

BOGOSLOFF ISLAND AND SHIP ROCK. FROM A PHOTOGRAPH BY LIEUT. G. H. DOTY, 1884.

Grewingk is less sharp than Bogosloff. As nearly as could be determined through the steam-jets, the highest peak of Grewingk is less than four hundred and fifty feet, and its base is somewhat over three thousand feet long. A deep ravine which apparently represents the crater, but is too full of steam to afford a fair view, extends in a north-easterly direction through the upper third of the mass, and cuts off a peak south-east from it, estimated to be four hundred feet high and about one-fifth the volume of the whole summit. The sides of Grewingk rise with a slope varying from ten to forty-five degrees; near the base it is gentler; and the surface of soft ashes, thickly covering broken rock. The slope, after the first three hundred feet, becomes steeper, and chiefly of loosely piled rocks; at two-thirds of the total height from the base, a wall of volcanic pudding-stone checks further progress. On the north-west side many irregular rocks appear: the other sides are more thickly strewn with ashes. There is no lava. Many steam-jets are visible, but are noiseless or only purr slightly. In one place, two-thirds of the way up, there is a group of fifteen jets on a nearly horizontal plane, which were notable for the force with which the vapor was emitted, and for their intermittent regular pulsing. All the vents were surrounded with dendritic sulphur crystals.

There were but few and slight earth-trembles experienced by the party while on the island. It is quite possible that the spit now connecting the two peaks is a later formation, not existing at the time of Hague's visit. Such spits may be formed or destroyed in a single winter storm. The Corwin party, however, thought this had merely been elevated from the sea-bed with Ship Rock, but without the participation of the old peak. It is at present composed of fine black sand, and gray, black-spotted, water-worn pebbles, without vegetation, and may be covered with breakers during heavy storms. It is less than four thousand feet long, and about three hundred and twenty-six feet wide at its narrowest part. W. H. DALL.

THE CHOLERA EPIDEMIC IN PARIS AND IN YPORT.

WE reproduce to-day two diagrams, showing the course of the epidemic of cholera in Paris in November. They are both taken from recent numbers of the *Revue scientifique.*

Examining the first diagram, we find that the first case entered the hospital on Nov. 4 ; that on the 5th there were ten new cases; and that the number ran up very rapidly, until, on the 11th of November, one hundred and thirty-two new cases were reported from the hospitals alone. From this date the number of cases diminished, until, on Nov. 30, there were but two new cases, and two deaths; and immediately after this the activity of the epidemic became suspended. Taking the total number of cases recorded (1,002), and comparing it with the number of deaths (573), we have a mortality of 57%, — a rather startling result, under the circumstances; for it may be taken for granted, that under the care of a hospital staff, if anywhere, the best results are to be obtained in the treatment of this disease. It may be said, and with how much truth we do not know, that only the worst cases were entered at the hospitals, and that many of these were moribund at the time of entrance. Our impression is, however, that the cases were a fair representation of the average.

This diagram presents also the usual characteristics of a cholera epidemic, the stage of increase (Nov.

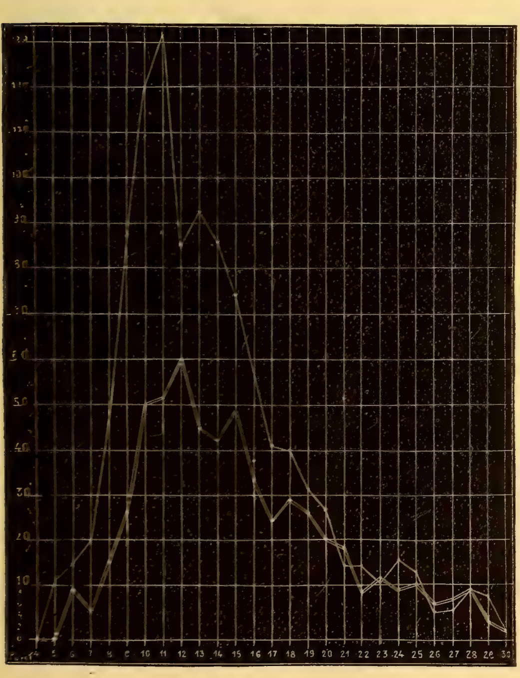


FIG. 1.

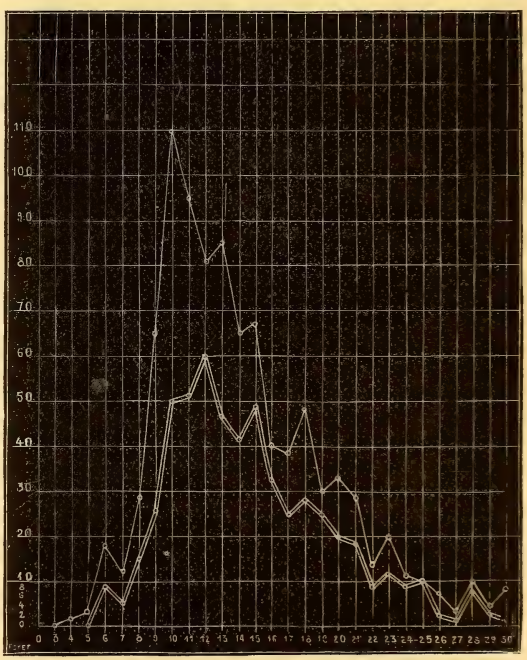


FIG. 2.

In both of them the double line is the curve of deaths; but in fig. 1 the single line is the curve of cases admitted to the hospital, whilst in fig. 2 it indicates the total number of deaths in the city and hospitals taken together.

The numbers along the foot of the diagram indicate the days of the month. The vertical columns show the number of entries and of deaths in fig. 1, and the number of deaths in fig. 2.

4–10), the stationary stage (Nov. 10–14), and the period of decline (Nov. 14–30). This, of course, is but a representation in miniature of what occurs in outbreaks that are spread over a greater extent of time. The suddenness of the decline of the epidemic may be due, in part, to the vigorous measures taken to stamp it out; but its disappearance is to be ascribed mostly to the frosts of the last of the month, which were frequent and rather severe.

The second diagram presents in a graphic manner the comparative rate of mortality in and out of the hospitals. From it we find that the total number of deaths from cholera from Nov. 3 to Nov. 30 was 916, and that 343 of these took place in the city at large. We regret exceedingly that the total number of cases in the city is not at hand for purposes of comparison with those in the hospitals. The question of the advantages of hospital treatment for such cases is still an open one in certain quarters, and may be settled in some measure by a study of this epidemic.

The conclusions to be drawn from the charts are that the outbreak was not an extended one, although it was widely diffused throughout the poorer parts of the city; that its virulence, as a whole, was equal to that of others, the rate of mortality being fully up to the average; and that the recent advances in sanitary science are not yet so thoroughly perfected and crystallized that their application to practical purposes produces a visible effect in the restraint of a pestilence, when occurring in a large city.

What may be done in a small community which is thoroughly under medical control is illustrated by an account, by Mr. Gibert, of an outbreak of cholera at Yport, near Havre.[1] This epidemic is as interesting and complete in its details as a laboratory experiment. The community is small and isolated, contains sixteen hundred inhabitants, and is out of the direct line of travel. The source of the disease was traced with precision to two sailors who reached the village Sept. 28. One of them had had an attack of cholera at Cette; and on the day after his arrival at Yport he soaked his soiled clothing, and hung it out to dry in front of his house, allowing the dirty water to run along the street.

From this nidus the disease started, and there occurred forty-two cases with eighteen deaths. Without following the account further, it will be interesting to read Gibert's conclusions — justifiable, apparently, from the account which he gives. They are, —

1. That cholera was brought to Yport.
2. That it was brought by insufficiently disinfected clothing, soiled by cholera dejecta.
3. That, after this clothing was washed, it became the agent of severe and rapid contamination.
4. That the cholera was propagated, by means of contagion, from house to house, without its being possible to attribute a single case to the transportation of the specfiic germ by the air.
5. That the sanitary measures taken, although incomplete, inasmuch as it was not possible to separate the sick from the well, were sufficient to stamp out the epidemic.
6. That the complete destruction of the cholera dejecta, and the disinfection or destruction of all effects soiled by them, seem to be sufficient to stamp out an epidemic of the disease, when it has not attained too great proportions.
7. That contagion by the air (the common acceptation of the term) appears to be an error; for at Yport three nuns and three physicians, or students in medicine, lived for a month under the most favorable conditions for taking the disease by this channel. They all escaped, with no further precautions than taking their meals at a distance from the cholera patients, and avoiding the handling of moist and soiled clothing.
8. The question of water has no bearing in this case, for the very good reason that the Yportais never drink any.

[1] Revue scient., Dec. 6, 1884, No. 23, p. 724.

AN AMERICAN COMMUNE.

THERE is at present a wide-spread feeling, both among scholars and men of affairs, that the time has come for an abandonment of that economic method which consisted largely in verbal quibbles and scholastic controversies about definitions of conceptions, and for a substitution in its place of a careful examination into the phenomena of this wonderful life of man in society which has received so little attention from science. The question is asked, "Why not study economic phenomena as we study the phenomena of plant or animal life?" And surely it seems as interesting and as important to observe the social life of man as that of ants in an ant-hill. It was with this conviction that Dr. Shaw undertook the preparation of this little volume on Icaria; and he was fully conscious of the fact that he was treating communism from a new stand-point, as is shown by these words taken from the preface: —

> "A great number of books and articles have been written in recent years, discussing socialism and communism in the abstract; . . . and there would be no reason for the present monograph if it also undertook to enter the field of general discussion. Such is not its purpose or plan. Certainly the most common defect in the current literature of social and political questions consists in the tendency to generalize too hastily. Too little diligence is given to searching for the facts of history, and to studying with minute attention the actual experiences of men. In the following pages an attempt is made to present the history of a single communistic enterprise; . . . to picture its inner life as a miniature social and political organism; to show what are, in actual experience, the difficulties which a communistic society encounters; and to show by a series of pen-portraits what manner of men the enterprise has enlisted."

To prepare himself for his task, Dr. Shaw read the works of the French communist Cabet, the founder of Icaria, the publications of other Icarians, and passed a week with them. This volume is, then, a careful study, conducted in the spirit of modern science.

Icaria, with its romantic and interesting history, is an example of pure communism, and as such has important lessons to teach.

Icaria: a chapter in the history of communism. By ALBERT SHAW, Ph.D. New York and London, *G. P. Putnam's Sons*, 1884. 9 + 219 p. 16°.

One impression gathered from the pages of this work is the almost religious fervor with which communists are devoted to their peculiar social creeds. Ridicule is unable to turn them aside from their purposes, and repeated failure does not shake their faith. Speaking of the charms which the community at Brook Farm found in their life, and their unwillingness to change it for the 'luxuries of Egypt,' Dr. Shaw remarks: —

"Some such feeling as that seems to be permanently retained by almost all who have ever engaged in community life. It is a notable fact that many of these people who have enlisted in the work of human amelioration have their wits wonderfully quickened thereby, while the one-sidedness of their development tends to deepen and confirm opinions once received. The ill-fated colonies of Robert Owen had passed into the history of 'extinct socialisms' a generation ago; and yet the writer himself might designate one and another and another of the now venerable associates of Owen, still fresh with enthusiasm, and warm with sympathy, for every proposed social reform. The last of the Fourièrist phalansteries disappeared before the war; but many of the men who were engaged in them may still be found wrestling with the problems of co-operation, or pounding away at something more radical. Icaria once numbered its hundreds of disciples. Most of them have disappeared, seemingly swallowed up in the mass of American society; but, if the truth could be ascertained, they would, in all probability, still be found to be communists at heart" (pp. 176, 177).

A second lesson which Icaria teaches, is that the difficulties in the way of a realization of communism have existed largely in the imperfections of human nature. Attempts to erect a social fabric of a new design have shattered, because the building-material was not strong enough to resist the strain to which it was subjected. It is a sweet thing for brethren to dwell together in unity, but truly a most difficult thing. While in Nauvoo, Ill., their first settlement, Cabet early leads one party of Icarians in violent attacks on an opposite party; and the controversy waxes warm and bitter, until a disastrous split separates the two sections permanently. Cabet dies poor and broken-hearted in St. Louis, his adherents are soon scattered, while his opponents found a new settlement in Iowa. But these latter, united in poverty and trial, are unable to endure prosperity; and a young and progressive party, unwilling to accede to the policy of their more conservative elders, effect a separation. Peace and prosperity have never remained long with the Icarians, but they have never ceased to persevere in hope of better things.

One of the most interesting and at the same time touching passages in Dr. Shaw's book is that which describes the beginning of a system of private property, and the relentlessness with which it was suppressed as soon as discovered. It appears that the privilege had been granted each family of cultivating a small plot of ground surrounding the house, in such manner as the members thereof thought good: this was the origin of the question of the 'little gardens' ('*les petits jardins*').

"Everywhere else in the community the Icarian motto (all for each, each for all) was the invariable rule. If, in the one matter of these tiny plots environing their humble domiciles, the Icarians allowed the idea of '*meum et tuum*' insidiously to enter, and if they found a keener enjoyment in the flowers or the grapes because of the forbidden but delicious sense of ownership, we must not condemn them too harshly, nor impeach their communism. There was something noble and pathetic in the manner with which these 'citoyens' and 'citoyennes' put away the accursed thing when they awoke to a realization of the fact that the gardens were introducing a dangerous element of individualism and inequality" (p. 101).

This unpretentious little book on Icaria may be commended as a contribution to social science well worthy of careful perusal. It may be proper to state, in conclusion, that the book was presented by its author to the authorities of the Johns Hopkins university as a thesis for the degree of Ph.D.

THE PHYSIOLOGICAL ANATOMY OF PLANTS.

THIS is the best sketch of plant-life that we have seen. The author criticises Sachs's view that the cell is merely passive, and shows that we must recognize both the separate individuality of the cell and the corporate unity of the complex plant, though in the higher plants the independence of the cell is largely subordinated to the general weal. He also rejects Sachs's 'Fundamental system' of tissues as being a heterogeneous assemblage, and as in no sense a physiological unity. The right classification of tissues is shown to depend neither on embryology (for mature tissues show no embryological unity) nor on collocation (whether outside or inside the thickening ring), but on their actual structure as related to their functions. Thus the tissues are arranged as protective and nutritive, — the protective including dermal and skeletal (or mechanical) systems; and the nutritive including absorbing, assimilating, conducting, storing, respiratory, and secreting organs. The bulk of the book is occupied with the anatomy of the plant as dependent on its functions.

Physiologische pflanzenanatomie, im grundriss dargestellt. Von DR. G. HABERLANDT. Leipzig, *Engelmann*, 1884. 12+398 p., illustr. 8°.

Under the protective system, we learn that cork and cuticle are a kind of fat, like tallow; the cork being impermeable to changes of temperature, and so securing slowness of freezing and thawing. The special secretions of ethereal oils have also been found by Tyndall to be useful in preventing the escape of warmth by night, and over-heating by day.

The mechanical system includes bast, wood-cells, and sclerenchyme; some parts resisting pulling forces, others resisting pressure. The bast-fibres of many plants surpass iron, and in some cases even steel of equal cross-section, in their power of bearing weights. Before winter the walls of the bast may thicken, becoming collenchyme, and the walls of cambium-cells may also thicken, as a means in both cases of storing food which is given back in spring. As a general rule, stems are strengthened to resist pressure, and roots are fortified against injury by pulling; and hence the circular arrangement of mechanical elements in the one case, and their axial situation in the other. But stems growing in water, and aerial roots, reverse the conditions, and accordingly the structure; so that we come to have root-like stems and also stem-like roots. The venation of leaves is directed to protect them from injury, and sometimes to roll them up, and so minimize evaporation. Some leaves in arid regions have 'water tissue,' with large reservoirs of water for times of drought.

Root-hairs are subsidiary to the surface of the young rootlets for absorbing water, and may occur on underground stems. They abound most in plants inhabiting dry places and in those which transpire freely; and are absent from Coniferae (whose transpiration is low) and from marsh-plants (where the water-supply is abundant).

The special assimilating organs are the palisade-cells of the leaves, the sponge-cells being only subsidiary. But the sponge-cells are important for transpiration; and in beech-trees the leaves in sunshine have much palisade-tissue, whilst those in shade have most sponge-tissue.

On the conducting system (*leitungssystem*) our author makes a wide, and we think a justifiable, departure from current doctrines. According to Sachs, the vessels of plants contain air, and the wood-cells carry water in the substance of their walls (we understand that Sachs has given up this view). Haberlandt shows that the water in the cell-walls is probably fixed as if crystallized; that the spring wood conducts water rapidly, though it is thin-walled; that water has been shown by Höhnel to be in the vessels; that in palms and tree-ferns there is too little prosenchyme to satisfy Sachs's doctrine; and that Sachs's experiments were defective and wrongly interpreted. The wood-cells are merely mechanical, and the water ascends through the vessels and tracheids.

Though the vessels may contain air-bubbles, they do not communicate with intercellular spaces or with stomata, and the low tension of the air in them would favor a suctorial rather than a supplying function. They have water both by day and night. The air appears in them when the day is somewhat advanced; and the alternate bubbles of water and air, like Jamin's tubes, favors Elfving's view of the ascent of the water by 'steps' (as a writer in *Nature* names it). The transverse walls of some vessels (as tracheids) support starch, which is too heavy for fluids; and the thin membranes permit the slow passage of water, but stop the passage of air. In pitted cells or pitted tracheids the diffusion surfaces are enlarged at the pits without the walls being weakened. The wide ducts of rattans afford quick passage for water by diminishing adhesion; whilst water-plants have few closed ducts. The long vessels are for through passage of water, and abound in stems; but tracheids are for local supply, and predominate in leaves of phanerogams and in some cryptogams.

Another part of the conducting system is the conducting parenchyme of the leaves and stem, including the parenchyme of the fibro-vascular bundles, the medullary rays, and the transparent parenchyme around the bundles of the leaves. These cells convey or store carbohydrates, as starch and sugar. Their proximity to the vessels indicates osmotic action, by which water and substances in solution pass out and in; the conducting tissue aids in the transmission of water; and the vessels may aid in the transference or storing of carbohydrates. The conducting parenchyme of the wood-region joins neighboring medullary rays, the contents of which can pass radially in the stem.

The conducting system for the proteids is the cambiform cells and the sieve-tubes, the perforations of the latter permitting the transmission of undissolved substances. Milk-ducts share in the functions of the sieve-tubes, reaching even to the base of the palisade-cells of leaves, and being abundant when the sieve-tubes are few.

The passage of air is by the intercellular spaces. Carbon dioxide can penetrate the cuticle; and both stomata and lenticels can open and close so as to regulate the supply. The stomata of plants inhabiting arid regions are

kept permanently closed, or are protected by ante-chambers; and those of some marsh-plants cannot close at all. In sunny places the air in the intercellular spaces is in motion, and may be observed passing out by the stomata. During the life of the plant, two maxima of transpiration occur: (1) in youth, the air passing through the soft cuticle; (2) in adult life, when it passes by the stomata.

The suggestion of Sachs, that the narrowness of the cells of autumn wood of trees results from tension, is unsatisfactory, because the change from broad to narrow cells is sudden, and the tension upon the young wood is nearly the same in autumn as in spring. How the difference is caused is not known; but it benefits the tree by affording wide channels for a plentiful supply of water for the opening leaves of spring and for the excessive transpiration of summer, and, on the other hand, by providing thickness and strength to meet the stress of winter. G. MACLOSKIE.

TROWBRIDGE'S PHYSICS.

ALL who are interested in the improvement of elementary science-teaching must regard with no little interest the announcement that a physicist of Professor Trowbridge's deservedly high reputation and great experience has taken time to prepare a text-book in physics for secondary schools. 'The new physics' is certainly not of the common type of text-books, and it will be generally welcomed as, in many respects, a new departure.

Exercises in measurement occur from the beginning, and the student is shown the importance of 'finding out things for himself' at an early stage. The book is rich in suggestions concerning the construction and use of simple forms of apparatus, by means of which important physical constants may be determined with some precision. For linear measurement such instruments as the vernier, the spherometer, the cathetometer, and the microscope with cobweb micrometer eye-piece, which are often among the more expensive appliances of a physical laboratory, are described, and their construction so planned as to tempt any enterprising high-school teacher to undertake their manufacture. Several ingenious methods of measuring small intervals of time are introduced, and most of them are so simple that their value can be tested at little expense. By means of these methods the laws of motion are investigated experimentally: in fact, the attempt is made to discover what these laws are, and not merely to verify them. The student is taught how to construct galvanometers and electrometers, and how to use them in electrical measurement. In short, what may be termed the laboratory method of teaching elementary physics is adopted by the author without reserve.

But it is a great disappointment to find a book containing so much that is fresh and original so marred by errors, many of which are really serious. The laudable attempt has been made to put the student in possession of certain principles of prime importance which are generally to be found only in the college text-book, and not always there. In the discussion of some of these, mistakes of considerable magnitude, and statements that are very misleading, have unfortunately found their way into the text. Of these, some of the most serious are to be found in the chapter on moments of inertia. In attempting to calculate, without involving the element of time, the force with which a steel spring strikes a pendulum ball, some inconsistent and extraordinary equations are produced. A little further on the reader will be astonished to find it demonstrated (?) that in a lever the products of each force by the *square* of its distance from the fulcrum are equal; and on this proposition the principle of moments of inertia is allowed to rest. The statement is also made that the radius of gyration is the length of the equivalent simple pendulum; and this error permeates the whole treatment of simple and compound pendulums. In the definition and discussion of equipotential surfaces the false assumption is made that force is constant over such a surface. Preliminary to the consideration of the work done by an electric current will be found a brief discussion of the dimensions of force and work, which is obscure and misleading.

There will be considerable difference of opinion about the propriety of inserting in an elementary text-book such matter as the determination of the value of the ohm in absolute units, the measure of the horizontal component of the earth's magnetism, and the measure of electromotive force by the 'throw' of a galvanometer-needle.

The book is extremely suggestive, and will be found of great use in the hands of the enthusiastic teacher. A second edition will doubtless be free from the numerous mistakes of the present, which can hardly be regarded as a safe guide to one not already tolerably familiar with the underlying principles of the 'new physics.'

The new physics. By JOHN TROWBRIDGE. New York, *Appleton*, 1884. 19 + 367 p. 12°.

NOTES AND NEWS.

A NOVEL event transpired at Boston last Wednesday, in the celebration, by Dr. B. Joy Jeffries and his friends, of the centennial of the first balloon voyage ever made across the English Channel, which was undertaken by his grandfather, Dr. John Jeffries, on Jan. 7, 1785. In this connection, Dr. Jeffries has happily printed, in the current number of the *Magazine of American history*, the original diary of Dr. John Jeffries, illustrated by three excellent portraits, one representing him as taking his voyage. The account of the trip is exceedingly interesting, and told in very simple language. But many persons would doubtless be more attracted by the naïve account of his reception in Paris, and the honors which he received during his six weeks' residence there. It gives a vivid picture of society, at the time, in that gay capital.

— A party of German explorers, consisting of Dr. Karl von den Steinen, Wilhelm von den Steinen, and Otto Klaus, has just reached Rio de Janeiro, after a journey of five months through the least-known part of Brazil. Starting from Cuyaba, capital of the province of Matto Grosso, in May, these gentlemen went by land to one of the head waters of the Xingú, — to which they gave the name of Batovy, in honor of the president of Matto Grosso, who furnished an escort, and in other ways aided the expedition, — and, embarking upon this stream in bark canoes made for the purpose, reached the mouth of the Xingú in October. The journey was rendered dangerous by the innumerable rapids of the river, and by numerous tribes of Indians who had never before seen a white man, but was safely accomplished without a single serious accident. The results promise to be of great geographical and ethnological interest. The Xingú, which is thus added to the small number of Brazilian rivers that have been accurately explored and mapped, has been the least known of all the great rivers of the empire; and its valley has become the centre of the unknown Indian country from the driving-in of the more intractable tribes by the advance of civilization along the Tocantins, Tapajos, and Upper Paraguay. Its lower course was explored in 1842 by Prince Adelbert of Prussia, to a point above the great bend; but the upper course has only been known from the somewhat vague accounts of missionaries and traders of colonial times, which have, until recently, been overlooked by Brazilian geographers. Represented with tolerable accuracy on the earlier maps, it has, during the last thirty or forty years, been a sort of geographical shuttlecock, each succeeding map introducing some erroneous correction. An important stream, the Paranatinga, an affluent of the São Manoel, branch of the Tapajos, or perhaps the upper course of that river, was first transferred to the Xingú. When this mistake was discovered, through a consultation of ancient documents, another was committed by taking three or four degrees from the length of the Xingú on the supposition that there was not room for its source near the parallel of 15° south, between the Paranatinga and the Araguaya. The present explorers report that the river flows through a fine country very abundant in rubber, but that it is too much obstructed by rapids to become a commercial highway.

— Agricultural experiments continue at Houghton farm (Mountainville, Orange county, N.Y.), on the general plan adopted in 1879, but with some extension and modifications. In the line of agriculture proper, the chief work is the comprehensive study of the Indian-corn plant, and experiments in rotation of crops, as inaugurated by Dr. M. Miles. Ten acres are devoted to this branch. One report has been published, and another is in preparation. The experiment-orchard planted by Professor Penhallow, and covering three acres, is doing finely, and promises results of value to horticultural interests. Meteorological observations are carried on, — atmospheric, surface, and subterranean temperatures receiving especial attention, — and an annual report is printed. In this department, instruments have been lately installed to secure continuous records. It is so difficult to thoroughly provide for animal experiments, that these have been undertaken only in a somewhat desultory way. Miscellaneous investigations, all related to practical farming, are carried on as time and circumstances permit. It is understood that Mr. Valentine is in search of the right man, with scientific training, faculty for original research, and taste for farm-life, to take the immediate charge of the experiment department at Houghton farm. The time of Major Alvord, general manager, is so occupied, that he can only give the work of this department a general supervision.

— W. Köppen, editor of the *Meteorologische zeitschrift*, has published, according to *Petermann's mittheilungen*, a chart of the zones of temperature from a new point of view, having taken as a divisional mark the length of the hot seasons according to their real relations, without reducing them to an ideal average. The tropical zone embraces those regions in which all the months are hot, that is, have a temperature of 30° C; the subtropical, those in which, during from four to eleven months, the mercury reaches that point. The temperate zone, with from four to twelve months in which the ruling temperature is from 10° C. to 20° C., he divided into regions which are marked by a uniformly temperate climate, those in which the summers are hot, and those with a moderate summer and cold winter. The frigid zone contains only regions with but from one to four months of moderate temperature; the polar circles, those where in no month does the mercury reach 10° C. In addition, there is shown on the chart the boundary of the northern ice-field, the isothermal line of 10° C., and the boundary of the four months' cold (under 20° C.) In the accompanying explanation, Mr. Köppen points out the influence of temperature upon the organic world, — shows that the boundaries taken by him very often agree with those of distribution of animal and plant life.

— Dr. Lacerda of Rio Janeiro, who has for some years been investigating the subject of snake-bites, now states that the poison of other snakes does not

differ in its effects from that of the rattlesnake, a view also maintained by Dr. Mitchell. The cure by means of injecting permanganate of soda into the bite has been subjected to further experiments by Dr. Lacerda. These prove that the injection must be fresh, and done immediately, and would be of no avail if the bite had penetrated an artery; also the injection must be made frequently, and all round the bite. He has already cured several cases of snake-bite thereby.

— The Russian geographical society has received a report from its member, M. A. V. Adrianof, who is travelling in the Altai and Sayan ranges. After traversing the Shapshalka Pass, he followed the course of the river Kemtsik, a branch or tributary of the Ulu Kem. In these regions he met with only a few Russian traders, but found a colony of Russian dissenters, who settled near the Chinese frontier in the time of the Patriarch Nikon, and placed the whole of their joint property under the uncontrolled administration of their leader, forming themselves into a kind of commune. Their occupations are agriculture and hunting. The native population which surround them manufacture a sort of felt, and have learned to weave a tissue of wild hemp. They prepare an intoxicating drink from milk, which they consume in notable quantity. These peoples who live in the basin of the river Kemtsik are Sayanians, or Sayantsi. They display a remarkable capacity for mixing with neighboring races without being merged, — a process which, however, succeeds better with Turanian and Finnic than with Mongolian tribes. There exist some important and interesting monuments of the past among these Sayanians, who are also known under the appellation 'Tuiba,' in their burying-places. These are either marked by conical cairns, or are flat areas surrounded by a circular row of stones, which are sometimes plain, but often covered with figures and inscriptions, and bear in some instances rude representations of the human figure. Remains of sacrifices, generally of a horse, are found near the tombs.

— The Russian explorer, Col. Prjevalski, spent last summer in exploring the plateau lakes of Thibet. The height of those at the source of the Yellow River he estimates at 13,500 feet, and those of the plateau at a thousand feet more. The climate he describes as detestable, cold, snow or rain, the whole summer through. The quantity of rainfall brought from the Indian Ocean by the south-west monsoon is so great that all summer the north of Thibet is one great swamp. Fish and quadrupeds are numerous, birds rare, the flora poor but peculiar. Prjevalski's party was twice attacked by robbers, whom they successfully repulsed. He means to continue his explorations.

— About ten per cent of the plants collected in the north-western Mexican states by recent collectors prove to be new species.

— Prof. David S. Jordan has been appointed president of the Indiana university.

— J. Müller, a German mining engineer, has applied electrolysis to the rectification of light coins. The practice obtains of reducing the weight of over-heavy coins by dissolving off some of the metal with acid; but in Germany, at least, no attempt has hitherto been made to add metal to the coin by electro-deposition in order to bring it up to its proper weight. The method answers well for small losses of weight, because the metal added in that case does not deface the characters on the coin.

— The *Athenaeum* states that the government of Siam is about to take steps for the opening of the interior of its fertile territory. With this object, an expedition for survey and exploration will shortly set out for Kabin, where there are said to be mines of considerable value. The idea is to connect this place with Bangkok by a railway, which would be ultimately carried on to Karat, Sohai, and Phitsalok. By this means Zimmay and the fertile region of Laos would be brought within convenient distance of the sea.

— The naturalist, Groum Grzhimailo, has returned from eastern Turkestan, where, during the past spring and summer, his expedition was mainly employed in investigating the zoölogy of the country. He has collected seventeen thousand specimens of lepidopterous insects, of which a large number are of hitherto unknown species. The altitudes of many mountains were taken, and thermometrical readings registered throughout the journey. The general observations of Grzhimailo tend towards an affirmative solution of the contested question of a glacial period in central Asia. He reports the existence, on Thian-Shan Mountain, of forms which up to now had been found only in North America, Lapland, and the Swiss Alps. This explorer proposes to start next year from Samarkand in order to pursue his researches on the western spurs of the Thian-Shan range, which have not as yet been the object of zoölogical investigation.

— Mr. Edwin Guthrie has published a pamphlet on the development of the art of numeration, in which he has brought together in a condensed form a very considerable amount of information on a most interesting subject. The pamphlet includes a table of the Assyrian, Egyptian, Hebrew, Greek, Roman, and Arabic systems of notation.

— The ninth volume of the *Ornithologist and oölogist* forms a large octavo volume of a hundred and fifty-two pages, and, as regards both quality of matter and literary execution, is greatly superior to any of its predecessors. It consists wholly of original matter, and contains very little trash, and a large amount of valuable information, particularly about the nesting-habits of little-known species. It is carefully printed on heavy paper, is creditable to its new publisher and editor, and has a fair claim upon the attention of the ornithologist as well as the non-scientific bird-lover.

— Clermont Ganneau is publishing a book entitled 'Les fraudes archéologiques en Palestine' (Paris, *Ernest Leroux*). This volume, illustrated with numerous engravings, contains a full account of the false Moabite potteries at Berlin, of the celebrated Shapira Deuteronomy, and of different spurious monuments of Palestine and Phoenicia.

— The dean of Clonfert has in the press a work on 'The general principles of the structure of language.' Trübner is the publisher. The work contains grammatical sketches, drawn up with great minuteness, of about a hundred and twenty languages, African, American, Oceanic, Asiatic, and European.

— The latest part (tomo vi. 2, 3) of the bulletin of the National academy of sciences in Cordoba, Argentine Republic, has been received. It contains two geological papers, — the first by Florentino Ameghino, on a series of geological and paleontological excursions made in the province of Buenos Aires; and the second by Adolfo Doering, on certain artesian borings in the Argentine Republic.

— Under the title of 'La rage et les expériences de M. Pasteur,' Gaston Percheron has published an excellent little treatise on hydrophobia (Paris, *Firmin-Didot*). The work gives briefly a clear account of all that is known of the malady, with the latest discoveries of Pasteur respecting the protective vaccination of dogs against rabies, and the confirmatory report of the commission appointed by the French government to control the test experiments. The description of the primary symptoms of the malady in dogs is interesting, and may be useful. The treatise is written in a popular style.

— The *Illustrirte zeitung* gives an account of the exploring of the mysterious little river, Reka, which rises in the Carinthian Alps, disappears, and emerges again in Istria as the Timavo, finally flowing into the Bay of Monfalcone. An exploring party from the village of St. Canzian last March entered the grotto into which the river disappears. For sixty yards the boats went along a narrow channel bordered by walls a hundred metres high; then a cavern was reached, where the party was obliged to land, as the current was too strong for the boat. They followed the left bank of the stream along the rocks until it was only four metres broad, when they crossed it on a plank, then followed the right bank until they came to the sixth subterranean waterfall. The magnesium light showed calm water below this. Four explorers started again on the 9th of November, and reached a seventh waterfall.

— 'Danger-lines and river-floods of 1882' is the title of Signal-service note xv., by H. A. Hazen, junior professor in the office of the chief signal-officer. The height at which floods become dangerous is given for forty-seven cities, arranged alphabetically. This is supplemented by special notes descriptive of the conditions of danger at these stations. In accordance with these measures, warnings can be issued as the rivers rise. The excessive floods of 1882 in the Mississippi basin are referred to an unusually early spring, causing a rapid melting of snow, combined with excessive rainfall, which caused simultaneous high water in both the Ohio and Mississippi rivers. The progress of the flood-wave crest down stream is found to occupy from three to eight days (mean, five and seven-tenths) between Cincinnati and Cairo, and from eleven to twenty-four (mean, sixteen and eight-tenths) from Cincinnati to Vicksburg. In general, the higher the water, the longer is the time of movement. The statement has been made in the flooded district, that, "if the river-banks were now as heavily wooded as in the great flood of 1824, the water would have risen ten feet higher in 1882 than it did." To this Professor Hazen answers, that the same heavily wooded condition of the banks farther up stream would have held back the water, retarded the supply, and thus reduced the height by distributing the flood over a longer period. The value of property lost in the floods of 1882 in Tennessee, Mississippi, Arkansas, and Louisiana, is roughly estimated at nine and a half millions: the loss of life was a hundred and forty-eight.

— The city of Providence, being embarrassed about the disposal of its sewage at the head of a tidal bay, sent two of its engineers to Europe last summer to investigate the various processes practically employed there to accomplish the desired end. The resulting report has been recently issued in an octavo volume of a hundred and fifty pages, with many plates and maps. It contains recommendations to the effect that 'intercepting sewers' should be built so as to catch the sewage just before it flows into the natural channels of drainage, and that it should be thus carried to Field's Point, on the west bank of Providence River, near the southern limit of the city; that it should there be treated by chemicals in such a manner as to clarify it by precipitation of suspended matter; and that the clarified effluent should be emptied into deep water off the point. The estimated cost of this arrangement is over three and a half million dollars. The report contains much material of interest; and Appendix A, on 'sewerage systems and sewage disposal,' which makes the greatest part of the volume, is a valuable historical and practical statement of the question.

— According to a telegram from Calcutta, Mr. Griesbach, the geologist with the Afghan boundary commission, describes the route between Guetta and the Helmund as presenting features very similar to those in the Pishin valley and Candahar; namely, a system of precipitous, deeply eroded ridges, extending from north and south to north-east and south-west. Extensive post-tertiary deposits fill the intervening valleys. The south-west extremity of the Ghazarband range is composed of sandstone shales and grits of the Flysch facies of eocene rocks. A series of low hills and valleys stretches between Canjpai and Nushki, which, from their composition, appear to be merely continuations of the Kojah Amran range, but near Galiahah the formation is distinctly younger, the epoch being mostly trap rock, which in places bursts through the cretaceous limestone overlying it, and locally converts it into white marble.

— The steamship British Prince reports that on Dec. 23, in latitude 40° 45′ north, longitude 66° west (about four hundred miles east of New York), from two A.M. to half-past five A.M., she had steady St. Elmo lights at yard-arms and mast-heads. The weather was overcast, dark, and gloomy, with torrents of rain, vivid lightning, and peals of thunder.

SCIENCE.

FRIDAY, JANUARY 16, 1885.

COMMENT AND CRITICISM.

The joint committee of the two houses of congress, appointed to consider the relations to each other of the different scientific bureaus of the government, not being ready to report when called upon last December, had its time extended to Jan. 15, and has meanwhile kept its deliberations and conclusions absolutely secret. All that is known is that it has taken a mass of testimony, and that the heads of bureaus concerned have had ample opportunity to render the committee all needful information, and to express their own views, most of which are well known. The committee, as our readers know, asked also the advice of the National academy of sciences (to which body one of its own members, Col. Lyman, belongs); and the text of the academy's report is published by us to-day on another page. We gave, some weeks ago, an intimation of its drift.

The report gives a brief account of the method in which such bureaus are organized in other countries; discusses at some length the character of the work done by the coast and geodetic and the geological surveys, especially in those points where their provinces are similar, pointing out that two distinct and independent trigonometric surveys of the United States are now in process of execution; distinguishes between the military and meteorological work of the signal-service, and recommends their complete separation; indicates the danger of duplication of work by the coast-survey and hydrographic office, but is not prepared to recommend that the latter be detached in any way from the control of the navy department, nor that the hydrographic work of the coast-survey, for over forty years conducted so satisfactorily, be separated from that organization, but suggests the lines on which it thinks the coast-survey should work; lays down the principle that the government should not undertake any work which can be equally well done by the enterprise of individual investigators, and that such work should be confined to what will 'promote the general welfare' of the country; urges the importance of a proper extension of the trigonometrical survey of the United States; and, finally, recommends the establishment either of a department of science, or of a mixed commission of nine members, — two of them scientific civilians to be appointed by the president for six years, two scientific men from the army and navy similarly appointed, three heads of the principal scientific bureaus, together with the president of the national academy, and the secretary of the Smithsonian institution. To the department of science, or to the supervision of this commission, it would transfer the coast-survey, the geological survey, and the meteorological bureau, and, in establishing a physical laboratory, add to it a bureau of weights and measures, the functions of which are now performed by the coast-survey. The province of the proposed commission is amply defined.

No more important measure, affecting the interests of science in this country, has been proposed since the chartering of the National academy of sciences with the functions of an advisory board to government departments. Whether the joint committee, and after them congress, adopt the suggestions of the academy, improve upon them, or utterly discard them, the principle upon which the government should conduct the scientific bureaus which it must of necessity maintain — the principle of proper co-ordination — has been struck; and at some time, if not now, it will prevail. No one who has watched the extraordinary and yet healthy growth of the geological survey since its re-organization five years ago — a re-

organization based upon this same principle, resulting from a recommendation of the same academy — can for an instant doubt the importance of applying that principle to all government work of like character which admits of it. It is not simply that it is the most economical and the most rational, the only scientific principle; but, removing sources of political disturbance, it will allow the natural and healthiest development of our resources, and affect the material advancement of the nation. Ultimately there will be an autonomous and independent department, on a permanent footing, on a level with those of war, state, and treasury, into which will be gathered all the bureaus of original research, of the sciences and industries, and of education, that are not indissolubly connected with already existing departments; as, the mint with the treasury, the hydrographic bureau with the navy, etc. Then we shall wonder why this result was not sooner reached. As it is, each step now tends, directly or indirectly, to that end; and, whatever possible rebuff the principle of co-ordination may meet with at the present time, — and we look for none worse than its oversight through political jugglery, — we may feel confident that it will rise again to the surface.

THE PRECISE method of accomplishing the end desired, which the committee of the academy has proposed, — that of a mixed commission of superintendency, — has found a critic before the joint committee of congress in Major Powell, the head of the geological bureau, whose views were given at length before the committee, and are printed in full in this week's issue, though without the discussion to which they gave rise in the committee, this having not yet been made public. Major Powell lays before the committee two fundamental principles which we believe no unprejudiced person, reading his full statement, will be inclined to deny: 1°, that the scientific institutions of the government should be placed under one general management; and, 2°, that the several bureaus engaged in research should be left free to prosecute such research in all its details, without dictation from superior authority in respect to the methods of research to be used. He objects, however, to a commission formed partly of civilians and partly of military men, as composed of incongruous elements, since military and civil methods of administration are entirely diverse, and proceed upon diametrically opposed theories. The military officer plans and commands: the civil officer hears, weighs, and decides. He makes a more forcible objection by showing how delicate the relations of a board composed largely of subordinate officials would be to the different heads of departments, since then the secretaries would simply become channels through which instructions to the very officials composing the board would be transmitted.

All must admit that at least the second of these exceptions is well taken, and it is therefore gratifying to find Major Powell constructive as well as destructive. He proposes that an already existing board should be invested with these new duties; one, too, which is excellently composed, and which would be in some respects more acceptable to the average congressman because chosen in large part by his suffrages, viz., the board of regents of the Smithsonian institution, — a board composed of the chief justice, the vice-president, three members of either house of congress chosen by the presiding officer, and six citizens chosen by joint resolution of congress. This plan would avoid the difficulties pointed out by Major Powell, and has the additional merit that the proposed co-ordination is then carried a step farther, since the institution itself would be under the same control. It would also render the further step to be taken (the creation of a department of science) much simpler, and less beset with difficulties, by removing one of the present chief difficulties in the way of any reform, — departmental jealousies. It is, however, too early yet to discuss this question fairly; for we have not yet before us the full development of Major Powell's proposition,

in the discussions which followed its presentation to the joint committee.

IN A RECENT number of the *Indian gazette*, Dr. Klein, who, with Dr. Gibbes, is now in India investigating the cholera, attempts to throw fresh discredit upon the theory of the specific nature of the comma bacillus of cholera. The grounds for his objections are these. He examined three houses in Calcutta where there had been a severe outbreak of cholera in November. He found the water-supply of all of them good. *Per contra*, at some distance from these houses, and never (?) used by their occupants, were three tanks of water which were swarming with the comma bacilli. The natives in the immediate neighborhood of these tanks used the water freely, and yet were practically free from the disease. Therefore Dr. Klein concludes against the specific nature of the comma bacillus. If this style of *post hoc ergo propter hoc* reasoning is what we are to expect from the English commission, confidence in their conclusions will not be readily given. Koch's position is simply that the cholera bacillus is a necessary condition to the occurrence of cholera, and this latest discovery of Dr. Klein proves nothing against it. It merely seems to show, what has already been granted, that the comma bacillus may be present without the occurrence of cholera. Circumstances favoring its development are, of course, necessary; and a receptive condition of the system must be established in order to its growth, — a fact which is true of all forms of bacteria, so far as they have been observed in relation to pathogenesis.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Coal in the Chico group of California.

THE California geological survey reached the conclusion stated by Professor Whitney in the preface to the second volume on the paleontology of the state, p. xiii., that the Tejon group is the only coal-producing formation in California. In the Proceedings of the California academy of sciences, Mr. J. G. Cooper has recently published a number of notes on the coals of the state. After remarking (vol. v. p. 385) that the Vancouver coal, and others in that region, are undoubtedly of cretaceous age, he states that "there is still some doubt as to those of California, which may be partly or entirely above the cretaceous strata."

Last summer, while engaged in the geological survey of the Cascade Range, a number of fossils were collected from the coal-bearing strata in northern California, eight miles north-east of Yreka, on the road to Linkville, Ore., and south of the cove at the Great Bend of Pit River, where considerable coal has been found. The fossils have been examined by Dr. C. A. White, who reports that they belong to the Chico group, and thus removes the doubt that some of the coal in northern California properly belongs to the cretaceous.

J. S. DILLER.

U. S. geological survey, Washington, D.C.

Man in the stone age.

In a communication to *Science* (v. 3) Dr. Brinton charges me with having forgotten what I read in de Mortillet's 'Le préhistorique.' I am at a loss just how to characterize his quotations from that work, which, like

> "The adventure of the Bear and Fiddle,
> [Begin] but break off in the middle."

De Mortillet wrote (p. 248), "L'accumulation de caractères simiens dans la race de Néanderthal montre clairement que l'homme primitif se rattache aux singes. S'il ne se relie pas directement aux anthropoides actuels, c'est qu'il manque entre eux et lui des échelons. Certainement il descend d'une forme ou d'un type intermédiaire. *Nous nous retrouvons donc en présence de l'anthropopithèque, dont j'ai démontré l'existence* (p. 102). Il suffit d'ouvrir les yeux et de regarder pour le voir ! Les anthropopithèques se sont montrés, se sont développés et se sont éteints pendant le tertiaire. L'homme a apparu au commencement du quaternaire. Cet homme primitif constitue la race de Néanderthal." Of this Dr. Brinton has chosen to quote only what I have put in Italics. He quotes de Mortillet as saying (p. 339) that the epoch of Moustier 'was characterized by the race of anthropopitheci.' What he actually says is, "L'homme de cette époque devait en majeure partie appartenir à la race de Néanderthal." Again: he says for the epoch of Solutré, de Mortillet "leaves the question open, denying that any traces of man or anthropoid have been discovered (p. 392)." His real language is, "Il résulte de tout ce qui précède que nous n'avons aucun document ostéologique sur l'homme solutréen."

I cannot pretend to be so well informed as Dr. Brinton upon 'the language, religion, and social compacts' of paleolithic man, but I do claim to know something about his *works;* and it is not 'word-splitting' to insist that the magnificent lance-heads of Volgu, in the museum of Chalons-sur-Saône, are quite as much the work of *man, properly so called*, as any 'stemmed scrapers;' nevertheless these belong to the epoch of Solutré.

I am well aware, that, in 1881, de Mortillet chose to substitute the term *chelléen* for *acheuléenne*, which he had suggested nine years previously. But the phrase 'axe of the St. Acheul type,' for the implement peculiar to that epoch, has become too firmly fixed in the nomenclature of prehistoric science ever to be misunderstood; except, possibly, by one who could say that Robenhausen belongs to the 'first epoch of the appearance of man on the globe,' disregarding all the marvellous artistic works of the cave-dwellers of Aquitaine, who belong to the preceding epoch of La Madelaine.

HENRY W. HAYNES.

Boston, Jan. 5.

The use of slips in scientific correspondence.[1]

An account of the 'slip-system of notes' was published by me in the Proceedings of the Boston society of natural history in 1867 (May 15, p. 242), after using it for more than a year. A fuller description is given in Wilder and Gage's 'Anatomical technology' (pp. 45-52). On p. 46 it is said that "slip-notes are of the following kinds: museum catalogues, library catalogues, references, extracts, statements of observations (original or otherwise, with or without drawings)."

During last summer I began to use slips in another way, suggested, perhaps, by the fact that *postal-cards* referring to a single point were frequently filed away with the slip-notes on the same subject. In my scientific correspondence I enclose slips (postal-card size) relating each to a special point. If written closely or with the type-writer, there is usually ample space, not only for the original note, but for an answer to it, if in the shape of inquiry: if not, a second is attached.

As compared with a letter in the usual form, such 'correspondence-slips' present the following advantages: 1. Each point may be attended to by the sender or the receiver independently of others which may require more delay; 2. Without transcription, the slips may be filed with others on the same subject; 3. The same slip, with or without attachments, may be sent back and forth, or to other correspondents, for comment or inquiry; 4. The date of each writing may be affixed, when desirable, either by hand, or by the use of Perkins rubber stamps, or other mechanical device.

As a matter of detail, I may add that I have found it convenient to keep by me envelopes addressed to those with whom I desire to communicate frequently upon matters of common interest, to insert the slips as they were written, and to send the letter as occasion arose.

Among those who have more or less fully co-operated with me in the use of slips in correspondence, should be named, especially, Dr. F. P. Foster, editor of the New-York *Medical journal;* Prof. H. F. Osborn of Princeton college; and my colleague, Prof. S. H. Gage. B. G. WILDER.

Ithaca, N.Y., Dec. 26.

American pearls.

Remembering an inquiry in a back number of *Science* regarding pearls, I thought it perhaps worth recording that small black pearls are not infrequent in the common Venus fluctifraga, V. succincta, and V. simillima of this coast. We also occasionally find white pearls in the larger Pachydesma crassatelloides. Haliotis splendens and H. Cracherodii are often pearl-bearers, pearls found in them often being of value and quite pretty. Martesia intercalata buries itself in the shell of Haliotis; and upon boring through, as it often does, the abalone covers the opening with a black, pearly layer, that frequently becomes a large protuberance on the inside of the shell.

C. R. ORCUTT.

San Diego, Cal.

The earthquake of Jan. 2.

The earthquake of Jan. 2 was felt distinctly in Washington. Making allowance for the error of my watch, the shock occurred at 9 h. 12.1 m. P.M., eastern standard time, and lasted ten or twelve seconds, accompanied by a rumbling sound, a rattling of windows, and a 'chattering,' jarring, unpleasant sensation communicated from the floor of the room in which I was sitting. The place of observation was about twenty-three hundred feet north-east of the naval observatory. The time may be half a minute in error, either way. WILLIAM C. WINLOCK.

Washington, D.C., Jan. 4.

[1] Read before the Society of naturalists of the eastern United States, Dec. 29, 1884.

THE PROSPECTS OF THE NEW PSYCHICAL SOCIETY.

THE STORY of the persecution of Galileo is now familiar to every one. In those days the church had ordained a certain system for the universe, and was disturbed by the discoveries of scientific men. Exactly the same feeling has been shown by two or three scientific men of the present day with regard to the prosecution of investigations of certain so-called psychical phenomena. One of our foremost scientific men has been heard to say, that, if the facts claimed to be true by the committee on thought-transference of the English society for psychical research were true, life would not be worth living. Men of this stamp say that they cannot in any way, or by any proof, be led to believe in the facts; but they would have all study of the alleged phenomena suppressed.

It is very fortunate that men of this 'dark-age' frame of mind are in the minority. Any one who saw the reception among scientific men which was given last summer to Professor Barrett, the emissary of the English society for psychical research, would see how deep-seated is the interest in such investigations, in spite of a healthy scepticism. There is no longer a feeling that such matters can be laughed out of court. As one result of Professor Barrett's visit, at a meeting held in Boston in September, a committee was appointed to consider the formation of an American society on a similar plan to that which Professor Barrett represented. A professorship had already been established in the University of Pennsylvania, and a man appointed to the chair who should devote his time more especially to the study of the physical manifestations known as spiritualism; a late wealthy citizen of Philadelphia having bequeathed a

sum of money for the purpose of testing the truth of the so-called spiritualism.

Since September, the Boston committee has held numerous meetings, and discussed the *pros* and *cons* of the formation of a psychical society, and finally brought forward a constitution under which some eighty gentlemen from different parts of the country have organized themselves. A notice of this meeting was given in No. 100 of *Science;* and in this week's issue we give an account of the completion of the details of organization. It will be seen in this account that the society proposes immediately to begin investigations on thought-transference. It is very necessary that this work should be in the hands of trusty investigators, and that they should have ample opportunity and means for carrying on their work. To some extent, they may find parties in private life who possess the alleged powers, but it may be necessary for them to call upon professionals; and, at any rate, it would be well if they were able to hire the professionals, and subject them to such experiments as would test their capacities. If there is a large proportion of fraud, one of the best works of the society would be to detect it, and publish it to the world; but this it cannot do, unless supplied freely with the necessary funds.

RECENT ADVANCES IN ELECTRICAL SCIENCE.

ELECTRICAL science has not made great strides during the year 1884; but in the direction of practical applications it is feeling the powerful aid of business ability and capital. The U. S. patent office is crowded with applications for patents on various electrical appliances. The scientific investigator must soon make a struggle for the free use of many old and familiar electrical appliances which he has known from boyhood, unless he, too, enters the field as an applicant for patents. The tendency of the times is certainly in the direction of obtaining patents in order to prove priority, even in the direction of pure science. We leave it to the moralist to decide the difference between a copyright for a literary man and a patent for a scientific man.

The problem of electric lighting is gradually yielding to the efforts of the great army of inventors. The Edison company has plants in almost all countries. The incandescent system has made its way on steamboats and steamships. The great Fall-River line of steamboats took the initiative in lighting the steamer Pilgrim, and has now extended the system to the other principal boats of the line. It is said, that, although the cost of lighting by incandescence is double that of gas, the better quality of light and the greater safety from fire counterbalance the increased cost. Experiments have been made by the Weston electric-light company during the year, upon long-filament incandescent lamps, which promise to give lamps approaching the candle-power of many arc-lights with a far pleasanter and steadier light.

Among the methods of electric lighting by incandescence, which have received renewed advocacy during the year, is the battery system. Trouvé's modification of the bichromate-of-potash battery consists in employing a very large proportion of sulphuric acid with bichromate of potash. An experience of three months with this battery will lead its most enthusiastic advocate to long for a cheaper source of electricity.

The problem of electric lighting is to find a cheaper motor than the steam-engine to drive the dynamo-electric engine, or to discover a more direct process of obtaining electricity from heat. No advance has been made this year in the generation of electricity by thermo-electricity. The meetings of the British association at Montreal, and the American association in Philadelphia, did not result in the production of many important papers on electricity; yet there is no doubt that many persons had their ideas clarified and their thoughts stimulated by these meetings. Perhaps the coming year will bear evidence of this. The electrical exposition in Philadelphia showed the great activity in the fields of electric lighting, and was chiefly interesting as an exhibition of various types of dynamo-machines.

The members of the electrical congress, also held in Philadelphia at the time of the electrical exposition, were inclined to dissent from the resolutions of the late Paris congress in regard to the adoption of a hundred and six centimetres of mercury, a millimetre in section, at the temperature of 0° C., as the legal ohm; since the work of Professor Rowland, it was believed, would give a closer value. Professor Rowland has not yet published; but it is believed that results have been obtained which will lead to a revision of the decision of the

Paris conference. The members of the conference also dissented from the conclusions of the Paris conference upon the adoption of the platinum standard of light; and a committee of the U. S. electrical conference is now engaged upon the study of a suitable standard. The suggestion by Siemens to use the light emitted by a square centimetre of platinum at the point of fusion, under the action of a known current of electricity, seems a fruitful one; and the committee is testing its capabilities.

In telegraphy and telephony, there is not much that is new to chronicle. It is perhaps a blow to our national pride to learn that we are behind England in the art of telegraphy, and that we are importing certain telegraphic instruments instead of exporting them.

The London central telegraphic office is certainly not approached in this country for completeness and system. There is a certain analogy between the action of the Irish settler in New England who burns up the fences and cuts down all the wood, and, in short, *skins* the farm, and the action of telegraphic and railroad corporations which run a system, but do not add to it as long as subsistence and dividends can be obtained. The American visitor to the London central office, however, can but be amused, that a separate room, with instruction, is provided for those operators who are to learn the reading of messages by sound. In America it was the operators who taught the superintendents that this method of receiving messages was preferable to the Morse register system.

We learn that the Bell telephone company has lately completed a special line between Boston and New York, and proposes to open telephonic communication between these cities. With the new powerful transmitters that have been and undoubtedly are to be invented, a great increase in the range of telephony is to be expected. Already most of the towns and principal cities throughout New England are connected by telephone-lines, to the great detriment of livery-stables and of stage-lines. The study of this new method of village-communication we leave to the political-economist. The system is destined to work great changes in manners and customs.

Unfortunately, the storage of electricity, so called, does not fulfil the extravagant hopes that were excited when Faure's battery burst upon the world. It is now found that the Planté battery is more practical than the Faure, and that, under careful methods of forming, it gives better results than the Faure and its various modifications. None of the storage-batteries now in use can be said to be commercial successes, for all of them deteriorate seriously in time. To the scientific investigator, however, they are extremely useful. One having a small electrical plant can charge his secondary batteries at his leisure, and thus have on *tap* a steady source of electricity. To the investigator who has ruined many suits of clothes with acid-batteries, and whose hands have almost ceased to be the insignia of gentle birth, the storage-battery is already a great boon.

Much has been said and written upon the subject of the transmission of power by electricity. It is proposed to try different systems upon a certain portion of the elevated railways of New York. Nothing but an experiment upon a sufficiently large scale, under intelligent scientific supervision, can determine whether the electrical transmission of power can compete successfully with the use of the locomotive on public exposed highways. There is a future for this system in many ways, even if it fails on railways. The year, however, has added little to our knowledge of it.

The subject of underground wires has been much agitated lately, and the Western union telegraph company has lately tried the experiment of placing many of its lines between two distant points in Boston under ground. At present they work successfully; but time is needed to show that a suitable degree of insulation can be maintained in this frost-afflicted climate.

The scientific theory of electricity has not received notable accessions during the year. The U. S. signal-service has established stations for the study of atmospheric electricity at Baltimore and at Cambridge. It is believed that electrical observations will give additional data for foretelling the approach of storms. The subject of atmospheric electricity is still shrouded in mystery; and little more is known than that there is a difference of electrical level between the earth and the air, and that this difference undergoes modifications, and that we have methods of measuring these modifications. Little progress has been made in our knowledge of the connection between earth-currents and changes in the electrical potential of the air. It is maintained by Mr. Blavier, who has had several experimental telegraph-lines under his direction in France for the study of earth-currents, that changes in the potential of the air cause very small changes in the character of earth-currents, and that the latter have a real and separate existence.

Lord Rayleigh has been engaged upon a study of the silver voltameter and its application to the measurement of electrical currents. He finds that one ampère deposits four grams of silver per hour, and a sufficient amount can therefore be obtained for accurate weighing in fifteen minutes. Pure nitrate or chlorate of silver gives the best results. Beetz has proposed a new form of Daniell cell, of great internal resistance. Fine alabaster plaster-of-Paris is mixed with concentrated sulphate-of-copper solution, and the copper electrode is fixed in this at one end of a glass tube: the rest of the tube is filled with concentrated sulphate of zinc and plaster-of-Paris, and the zinc electrode is also embedded in this. The ends of the tube are filled with paraffine. This form of cell has been tried at the Jefferson physical laboratory of Harvard university, and has been found an excellent substitute for the water-cell of zinc and copper for charging electrometers.

The lull in the progress of theoretical electricity is probably the precursor of important additions to our knowledge; for many investigators are at work, both at home and abroad, testing the new electrodynamic theory of light, and adding to our knowledge of magnetism. The equipment of physical laboratories in America, which has been one of the features of the year at Cambridge as well as elsewhere in America, bids us hope for much systematic study of the science of electricity, and physical science in general. JOHN TROWBRIDGE.

CO-ORDINATION OF THE SCIENTIFIC BUREAUS OF THE GOVERNMENT.[1]

THE land-maps of European countries are, as a rule, made under the direction of the war departments of those countries, and under the direction of officers of the army specially detailed for that duty, with the aid of experts in the business and in the arts necessary to the surveys and to the production of the charts, who are employed from civil life, and also of enlisted soldiers and non-commissioned officers detailed from the army.

For details on this subject, the committee refers to the printed notes on European surveys compiled and published in 1876, under the direction of one of its members, Gen. C. B. Comstock, U. S. engineers, as the most complete compendium on this subject known to them; also to some manuscript notes prepared by the committee from reports and publications of later date.

[1] Extracts from the report of a committee of the National academy of sciences, consisting of Gen. MEIGS, and Professors J. P. TROWBRIDGE, PICKERING, YOUNG, WALKER, and LANGLEY.

The hydrographic surveys of the coasts of Europe appear in every country to be the work of the naval establishment. On the coasts of the United Kingdom the hydrography has been completed; and now two parties in surveying vessels of the navy are constantly employed in re-sounding and examining channels, harbors, and shoals, in order to correct the existing admiralty charts. All this is done under direction of the admiralty.

While the organization of the land and of the hydrographic surveys in Europe are very perfect, your committee does not find that they offer any thing to improve that of the United States, except, perhaps, in showing the economy in time and money of greater use of photography and of zincography in the reduction and production of maps and charts. In Great Britain now the twenty-five-inch-to-the-mile map is published even earlier than those on smaller scales, all of which are reductions from the original manuscript maps surveyed and plotted on the twenty-five-inch or six-inch scale.

Early and cheap publications of results of operations in the field, if they retain the accuracy of the original maps, are of great industrial and economic importance. The English maps of the ordnance survey are published and placed on sale as soon as printed, and at very moderate prices.

Your committee would call attention, in this connection, to the report made by the National academy of sciences to congress in December, 1878, in which the advantages of a consolidation of the then existing surveys were pointed out. In that report, it was recommended that surveys should be two in number, — the coast and interior survey, to be concerned with the triangulation and mapping of the country and its topography; and a geological survey, to undertake geological and economical investigations. It would be a part of the duty of the former survey to supply the maps for the use of the geological survey; and, in order to secure the co-ordination and harmonious co-operation of the two surveys, it was recommended that the coast and interior survey be transferred to the interior department.

Congress adopted so much of this recommendation as related to the formation of a single geological survey, but did not provide for the proposed transfer of the coast-survey, nor make any other provision for the topographic work necessary for the geological survey. The result has been that these two surveys do not co-operate as they should. The chief of the geological survey has also found it necessary to employ large corps of men in trigonometric measurements.

Your committee does not feel entire confidence that the union of these two surveys under either one of the executive departments, would, without other measures, necessarily lead to that unity of work which is desirable. It therefore recommends certain further legislative measures, the occasion for which will be made clear by a review of the work done by these several organizations; but its members are entirely clear in the opinion that some one of the executive departments should control both. It is for

congress to determine which department shall exercise this necessary authority and control.

The coast-survey was originally organized for the purpose of constructing maps and charts of the coast and harbors for the benefit of commerce and navigation. Conflicting opinions respecting the proper management of the survey led to the formation, in 1843, of a board of officers with the duty of re-organizing the survey. This board submitted a plan which was enacted by congress into law, upon and under which law the survey has hitherto been executed. This plan provided for the co-operation of military officers, naval officers, and civilians in the various parts of the work. Under it the work of the coast-survey has been continued to the present time.

In recent times a great extension of the field of operations of the survey has been made, apparently looking to a triangulation covering the entire territory of the United States. The maps published annually with the report of the survey enable us to know the geodetic work it has executed. It appears, from the maps accompanying the report of 1882, that on June 30 of that year a chain of triangles had been extended throughout the entire length of the Atlantic and Gulf coasts, and throughout about half the Pacific coast. Besides these coast-lines, extensive regions in the interior are seen to be triangulated. In the north-east, the triangulation covers the greater part of the states of New Hampshire, Vermont, and Massachusetts, about half of Connecticut, and it also includes a considerable part of the state of New York.

The reconnoissance has extended westward from the New-Jersey coast, so as to include the greater part of the state of New Jersey, and a long strip in Pennsylvania. From Pennsylvania, the extended line of primary triangulation follows the Allegheny Mountains into northern Alabama, and is now being continued across the country to Memphis.

A triangulation of the Mississippi River was extended from its mouth nearly to Memphis, where it would meet the last-described chain of triangles. The chain connecting the Atlantic and Pacific coasts has been completed nearly across the state of Nevada, and the reconnoissance includes nearly half of Utah Territory. The line is also surveyed at various points in Colorado, Kansas, Missouri, and Illinois. Besides all this, isolated regions in Wisconsin, Indiana, Illinois, Ohio, Kentucky, and Tennessee, have been reconnoitred by the coast and geodetic survey, in a way indicative of a plan designed ultimately to cover the entire territory. As its appropriations for some years past have made provision for the collection of data for a general map of the United States, we may fairly regard the coast and geodetic survey as having undertaken a trigonometric survey of the whole United States.

From the statement of the director of the geological survey, we learn, that, under authority of the annual appropriation bills to prepare a geological map of the United States, that officer has parties engaged in the trigonometric survey of the entire country, which is to be sufficiently accurate for cartographic purposes. It appears, therefore, that two distinct and independent trigonometric surveys of the United States, under two different departments of the government, are now in process of execution.

The meteorological work of the signal-service is divisible into two distinct branches. The first and by far the larger portion of the work is the collection of weather reports from stations in different parts of the union, which are utilized in predicting the probable weather during the twenty-four hours succeeding. Connected with this work is the publication of weather maps, showing at a glance the state of the weather over the entire country at certain moments of absolute time. At the school at Fort Myer, observers and operators are trained for this service. A very important part of its work is the display of signals, and warnings of approaching storms, frosts, and floods.

The other branch of the meteorological service appears in scientific discussions and investigations having for their object the advance of the science of meteorology. These researches are published under the title, 'Professional papers of the signal-service,' which papers consist of memoirs separately paged, and numbered in the order of their issue. Your committee is not informed of the separate expenses of these two divisions of the signal-service, but has no doubt that the expense of the second branch is but a small fraction of that of the first.

The signal-service also performs a military duty, providing the material, and instructing soldiers and officers to communicate between separate bodies of troops by a system of day and night signals; and it also operates and repairs, and when necessary constructs, telegraph-lines for military purposes. The appropriation for these military works and services for the current year is five thousand dollars. In the opinion of the committee, it is desirable that the meteorological work of the weather bureau should be under the general control of the commission proposed later in this paper.

The hydrographic office of the navy department may be considered to date from the year 1848, when the depot for charts and instruments for the navy, authorized by an act approved in 1842, was established. Under this act an observatory was established, and was engaged in the double work of making astronomical observations, correcting chronometers, and of supplying charts to the navy; the establishment being officially styled 'the U. S. naval observatory and hydrographic office.' In 1866 congress authorized the establishment of a separate hydrographic office, to be attached to the bureau of navigation in the navy department, for the purpose of supplying nautical publications and information, not only to vessels of the United States, but to navigators generally. Before that time the functions of the office had been confined to the purchase and distribution of foreign charts. Under the new organization, a drawing and engraving division was established, which constructs charts of foreign coasts and seas for distribution to vessels of the navy, and for sale, at the cost of printing and paper, to navigators gener-

ally. The officer now in charge of the hydrographic office appeared before your committee in person, and gave it a very clear account of the work his office is actually doing.

Besides the hydrographic work of the coast-survey, — which is conducted, and has always been conducted under existing laws, under the direction of the superintendent of the coast-survey, — this hydrographic office is not only supplying corrected charts to the vessels of the navy, but is collecting information as to ice which endangers every ship or steamer of the great lines which connect our northern ports with Great Britain and France; and it also publishes constantly information as to changes in lights and buoys, and discoveries by all nations of shoals and dangers not laid down upon the charts in common use. It publishes at short intervals, not only printed information by bulletin sent to commercial centres in this country, but pilot charts, especially of the North Atlantic, giving the latest intelligence in regard to currents and winds, and the location, when last seen, of all floating wrecks and derelicts, and of the icebergs and other floating ice which through the whole spring, summer, and fall seasons, lie along the eastern edge of the Great Banks, directly in the track followed by hundreds of steamers and sailing-vessels, carrying many thousands of travellers, passengers, and immigrants, and the millions of dollars of our exports and imports.

This work of the hydrographic office is evidently of great value and importance to our commercial and business interests, and must save many vessels from wreck, and many lives from destruction. Naval vessels under direction and instruction of the hydrographic office also survey foreign coasts and unsurveyed harbors and channels, aiding powerfully in the extension and introduction of our commerce to such coasts and harbors; and they contribute to the knowledge of the earth and its inhabitants by deep-sea soundings, by observations of the currents and winds and storms, and of the bottom of the ocean and of its shores.

While this work is scientific work, your committee is not prepared to recommend that it be detached in any way from the control of the navy department; nor can they recommend that the hydrographic work of the coast-survey, for over forty years conducted so satisfactorily under the civil control of the coast-survey, be separated from that organization before the original survey shall be completed. After that is done, perhaps the work of re-sounding and of re-examining may, without injury to the service, be committed to the control of the navy department. Yet even then correction and revision of the coast-survey charts will require some co-ordination, some authoritative connection between the coast-survey office and the parties and vessels engaged in these re-examinations for correction of our coast charts.

From the terms of the act under which your committee is considering this subject, it may be inferred that the principal question affecting the hydrographic office, on which an opinion is desired, is that of its consolidation with the hydrographic work of the coast-survey. The reasons for the consolidation of these two works under the navy department have been urged with force by the secretary of the navy in his last two annual reports. But there are also cogent reasons on the other side of this question. The coast-survey was specially organized to secure the harmonious co-operation of civilians, officers of the navy, and officers of the army, each in his own department, and yet in a single well co-ordinated work. No scientific department of the government has worked more successfully through the forty years in which this organization has been in operation. Each of the three branches thus harmoniously co-operating has received the benefit of the skill and professional experience of the other.

An organization of this sort should not, while its work is going on, be disrupted, except for very strong reasons affecting its efficiency. We would also advert, in illustration of the advantages which our military and naval officers have derived from their connection with the coast-survey, to the brilliant list of military and naval men during the civil war, who derived a very important part of their professional training from their experience on that work. Such a list would include an array of professional leaders which it would be difficult to collect from any other associated body of men. We suggest the names of Porter, the Rodgerses, of Meade, and of Humphreys. Many others might be added, who, after service on the coast-survey, rose to high employments in the army and navy.

While, therefore, your committee is not prepared at the present time to recommend the proposed consolidation, it does not conceive that congress should adopt measures looking to the separation in perpetuity of the two branches under consideration. The policy of the coast-survey should, we conceive, be directed towards the completion at the earliest possible date of the survey of our coast-line. Its main operations will thereafter be confined principally to the interior, and then the policy of consolidating its hydrography with the work of the naval hydrographic office will be open for consideration. We are therefore of opinion that the hydrographic office of the navy department is worked with all due efficiency as it is now organized, and that no change is at present necessary in its relations to the government.

Preliminary to our recommendations as to the other three works upon which your committee is called upon to report, it desires to present some general views respecting the working of the departments of the government. We conceive it desirable that there should be a clear understanding as to what sorts of scientific investigation may be undertaken by government organizations. We conceive it to be a sound principle that congress should not undertake any work which can be equally well done by the enterprise of individual investigators. Our leading universities are constantly increasing the means of scientific research by their professors and students; and, while the government may with propriety encourage and co-operate with them, there is no reason

why it should compete with them. The scientific work of the government ought not, therefore, to be such as can be undertaken by individuals. It should also be confined to the increase and systematization of knowledge tending 'to promote the general welfare' of the country. Within these two restrictions there is a large and increasing field, which is only partly occupied by the organizations now under consideration. In considering the limits of its functions, your committee, as one of scientists and not of constitutional lawyers, naturally confines itself to considerations affecting the general welfare.

The general government having commenced a general trigonometrical survey of the United States on a large scale, under organizations much more efficient in their action than those which any single state can provide, we conceive it desirable that the work thus undertaken should be continued at least to the point at which it can be advantageously taken up by the states themselves. At what precise limit the general government should stop, we are not prepared to decide, nor is it necessary that this limit should be defined at present. The attention of congress should also be directed to the fact that the administration of a scientific bureau or department involves greater difficulties than that of a purely business department. The connections between the work done and the results ultimately to be attained for the public are not at all obvious to the people and press, and thus the great benefit of vigilant watching and constant criticism is wanting. Again: its administration requires a combination of scientific knowledge with administrative ability, which is more difficult to command than either of these qualities separately. These difficulties are intensified by the absence of any central authority to control the work of a government scientific organization. Each head of a scientific organization is now practically absolutely independent, and, in his individual judgment of what his organization shall do, is controlled only by congress itself, acting only through its annual appropriation bills. We conceive that this state of things calls for measures of reform.

A feature of such reform will be the collection of the organizations now under consideration, together with such other scientific bureaus as congress may see fit to include in the scheme, under one central authority, to be recognized as responsible for, and controlling generally, the scientific operations of the government. Various forms of such an authority might be devised, the choice of which will some day be made by congress. The best form would be, perhaps, the establishment of a 'department of science,' the head of which should be an administrator familiar with scientific affairs, but not necessarily an investigator in any special branch.

Your committee states only the general sentiment and wish of men of science, when it says that its members believe the time is near when the country will demand the institution of a branch of the executive government devoted especially to the direction and control of all the purely scientific work of the government. In this day the pursuit of science itself is, visibly to all men of education, directly connected with the promotion of the general welfare. The art of photography, beginning in 1802 with the scientific experiments of Wedgewood, has developed, till, in this country alone, the annual value of photographs produced is estimated at thirty millions of dollars. The study of electricity has resulted in the telegraph, the telephone, the electric light, the electric railway; some of which results count their revenue by millions, and have created already, within a few years of their discovery, properties employing the capital of hundreds of millions. None who have lived with open eyes during the development of these results of purely scientific investigation doubt that the cultivation of science 'promotes the general welfare.'

Should such a department be now impracticable, should public opinion not be now ready for it, the next best measure, in the opinion of scientific men, would be to transfer all such work or bureaus to some one executive department. Keeping in mind what has been said respecting the two classes of work under the signal-service, we are of opinion that the functions of the several organizations under consideration could now be most advantageously divided among perhaps four bureaus; namely, —

1°. The coast and interior survey, to be concerned principally with geodesy and hydrography, and to consist of the present coast and geodetic survey.

2°. The geological survey, to comprise the present geological survey with its organization unchanged.

3°. The meteorological bureau, to which should be transferred so much of the present *personnel* and functions of the chief signal-office as are not necessary to the military duties of that office.

4°. A physical observatory, to investigate the laws of solar and terrestrial radiation, and their application to meteorology, with such other investigations in exact science as the government might assign to it. In this connection, attention is called to a resolution passed by the recent electrical conference in Philadelphia, requesting the establishment, by the government, of a bureau of electrical standards. We are of opinion that the functions of the bureau of weights and measures, now performed by the coast-survey, could be advantageously transferred to the proposed bureau, and extended so as to include electrical measures.

The members of your committee are conscious that placing these bureaus under one department would not necessarily result in the proper co-ordination of their work, because the head of such department would probably find it impracticable to enter into the consideration of all details necessary to that purpose. It appears to us that the evils already pointed out require, in any case, the organization of a permanent commission to prescribe a general policy for each of these bureaus. The functions of this commission would be: —

1°. To examine, improve, and approve the plans of work proposed by the several bureaus, and to revise their estimates in accordance with such plan. The performance of this duty would require consultation with their chiefs generally and separately respecting

the character of their work, and they should be members of the commission.

2°. To approve in detail the methods of expenditure of the appropriations.

3°. To recommend such measures as they deem necessary to the efficiency of the bureaus under their supervision. It should, however, be understood that this commission is not charged with purely administrative responsibility. It prescribes what shall be done, and recommends any measures necessary to secure that object, but does not concern itself with administrative details.

We submit the following as a suggestion for the formation and *personnel* of such a commission: —

The commission shall consist of, 1°, the president of the National academy of sciences; 2°, the secretary of the Smithsonian institution; 3° and 4°, two civilians of high scientific reputation, not otherwise in the government service, to be appointed by the president of the United States for the term of six years; 5°, one officer of the corps of engineers of the army; 6°, one professor of mathematics in the navy, skilled in astronomy, — these two to be designated by the president of the United States for a term of six years, — who, with, 7°, the superintendent of the coast and geodetic survey; 8°, the director of the geological survey; and, 9°, the officer in charge of the meteorological service, — shall constitute the commission of ———. The secretary of the ——— department shall be *ex-officio* president of the commission.

The members of the commission, for their services as such, shall each be paid by the United States compensation in the sum of ——— dollars per annum. Their necessary transportation and travelling expenses shall be provided for as are those of officers of the army and navy when travelling on public business or duty, to be paid out of the appropriations for the services under their supervision.

The commission shall meet in Washington, D.C., for the transaction of business, not less than four times a year; but the president of the commission may convene it whenever in his judgment the exigencies of the service require a meeting.

The commission shall be attached to the office of the secretary of the department of ———, and under his superintendence shall exercise a general control over the plans of work of the coast and geodetic survey, the geological survey, and the meteorological service, and shall have the charge and custody of all the archives, books, documents, drawings, models, returns, apparatus, instruments, and all other things appertaining to the commission.

The estimates of the heads of these bureaus or offices shall pass through the commission for revision and approval; and, after the annual appropriations have been made, no money shall be expended under them, except after revision and approval by the commission of projects submitted by these bureaus in compliance with such projects.

If at any time public money is being spent by any of these bureaus, not in accordance with the views of the commission, the commission shall notify the proper auditor of the fact.

THE ADMINISTRATION OF THE SCIENTIFIC WORK OF THE GENERAL GOVERNMENT.[1]

In response to your oral request at the session of yesterday to present to the commission my "opinions relating to the organization of the scientific work of the government on a comprehensive plan, by which the work can be more thoroughly co-ordinated, more systematically prosecuted, and more economically administered, than at present," I beg leave to make the following statement: —

The scientific works prosecuted under the general government of the United States, and in like manner prosecuted by other nations, may broadly, but with sufficient accuracy, be classed under two heads. In the first class are constructive works, such as the erection of public buildings, the improvement of rivers and harbors, and the construction of lighthouses. In all of the operations of this class, in order that the work may be properly executed, scientific principles and methods must be observed; but such works chiefly involve problems of applied science. The second class of operations in which the government of the United States, like all other civilized nations, is engaged, involve in their nature original investigation. They are designed, in large part, to furnish needed information to the people; and they not only involve questions of applied science, but, that the purpose for which they are prosecuted may be properly accomplished, new facts and principles must be discovered. Such institutions are the geological survey, the coast and geodetic survey, the signal-service or meteorological bureau, the fish-commission, the national museum, the hydrographic bureau, and the national observatory. The functions of such bureaus cannot properly be performed without scientific research, and their value depends upon the wisdom and efficiency of the methods of investigation pursued. It is to this second class, of purely scientific institutions, designed for and necessarily comprehending original research for the purpose of giving information to the people, that I confine my remarks.

The operations of such institutions are exceedingly complex, and, from their very nature, cannot be antecedently planned and executed according to such original plan. At every step of the work, plans must necessarily be modified, as necessitated or suggested by discovered facts. It is therefore impossible by law to organize such operations; and, more, it is impossible for the directors or superintendents of such work to lay out plans of operations which shall be a full guide to their assistants. A clear conception of the object to be attained, and a comprehensive knowledge of the principles to be used in the guidance of research, are necessary; and beyond that, from time to time, as facts are discovered, and the avenues of investigation are opened, the work is directed in its details. It will thus be seen that it is

[1] From the testimony of Major J. W. Powell, director of the U. S. geological survey, before a joint committee of both houses of congress.

impossible to directly restrict or control these scientific operations by law. The general purpose of the work may be formulated in the statutes, and the operations may be limited by the appropriations made therefor, and this is as far as the statute itself can properly go; for, if the operations themselves could be formulated in law, the facts would already be known, and the investigation would be unnecessary. It being impossible by statute to control or restrict the lines of investigation, as above shown, there is yet a control of the official personal organization which can properly be exercised by statutory provision; and a further control, superior to the immediate organization prosecuting the work, may be properly exercised in relation to the financial operations in the payment of employees, and in the purchase, use, and custody of public property, and the supervision of accounts.

I beg permission to set forth certain facts, which, I think, should be used as a guide in the establishment of such official organization and superior control. In the first place, the investigations prosecuted by all of these scientific institutions are in their nature inter-related and interdependent. The success of one is dependent, to a large extent, upon the success of the others; and, if at any time in the correlated investigations prosecuted by the general government any one branch fails in its department, the other branches suffer therefrom to a greater or less extent.

For example: geodetic operations carried on throughout the world, and having for their purpose the determination of the figure of the earth, were for a long time prosecuted by refined trigonometric methods; but, as the work progressed, the problem was found to be more complex than was at first supposed, and elaborate gravity determinations were added to trigonometric methods. And it has quite lately been discovered that trigonometric and gravity methods must yet be supplemented by the determination of the geologic structure of lands, especially of mountains and mountain systems. Thus it has been found that the geographer cannot accomplish his work without appealing to the geologist for his knowledge. On the other hand, it has been found in the study of structural geology — and by that is meant the plan upon which the rocks composing the lands of a country are arranged — that it cannot be clearly understood and explained without the facts of geodesy. Sound geologic research, therefore, must progress hand in hand with sound geodetic research.

Again: in the prosecution of geodetic research, the parties thus engaged determine the exact position in latitude, longitude, and altitude, of many points upon the surface of the earth. In the prosecution of a geologic survey of the same territory, these same points must also be known; but, more than that, their number must be vastly multiplied, so that a map may be constructed setting forth the latitude, longitude, and altitude of all portions of the country surveyed. Where the geodetic survey establishes but hundreds of points, the geologic survey must have millions of points established.

Again: the points to be used in the geodetic survey must necessarily be selected for that purpose. A general reconnoissance of the country over which such a survey is carried must be made, and the materials collected for at least a skeleton map. Thus it is that a skeleton map is necessary for a geodetic survey, and a completed map for the geologic survey. In like manner it can be shown that the relations between geodetic and geologic work are manifold, and, still further, that the geodetic work and the geologic work have a great variety of connections with the other scientific works prosecuted by the general government. It would require a volume to set forth all these relations, and to show how completely the success of one is dependent upon the success of all.

It will thus be seen that the official organizations for these institutions should be co-ordinated, that they may work together and aid each other; and, further, as each is interested to a greater or less extent in the operations of the other, the organization should be such that one shall not be compelled to do that which is the proper function of another, and that no one shall be permitted to encroach upon the functions of another. As long as the several scientific commissions and bureaus of the general government are distributed through all the departments of the government, — one in the war department, another in the navy, another in the interior, another in the treasury, etc., — each bureau must necessarily, to a large extent, be autonomous: they must be self-governed, for it is a practical impossibility for any secretary of a general department to make such a study of the methods of scientific research as would warrant him in attempting their control. Hence these institutions have in the past been to a great degree autonomous, and must, under the same plan, continue to be.

If the statements thus briefly made are correct, it follows that the first guiding principle to the proper official organization of the scientific work is as follows: *The scientific institutions of the government should be placed under one general management.*

Again: as a necessity, scientific investigation must be controlled by the facts discovered from year to year, and from month to month, and from day to day. The operations of investigation, therefore, can only be controlled by the men who are actually performing the work. For example: the director of the geological survey cannot possibly lay out the work for his assistants in detail. He can only set forth in a general way the object to be reached, the general methods to be pursued; and such plans must be held open to revision from time to time as the facts discovered by the investigators themselves may demand. He must therefore hold himself always in communication with his assistants, and ever be ready to entertain their suggestions; and there is always a probability that he will err more in the direction of rejecting wise suggestions than accepting unwise plans.

It is thus that, to a large extent, the plans of the work prosecuted by an organization for scientific research must originate with the experts and specialists who are themselves engaged in the investigation; and

the most important function which the director of such an institution has to perform, lies in the selection of the proper men, — the specialists who have a genius for research. From the very nature of the work performed, the plan of operations to a large extent must come up from the individuals who are doing the work, and can only to a limited extent originate with the director. Out of the multitude of plans and ideas thus suggested by a corps of specialists engaged in original research, the superintendent or director selects such as he thinks wise, and is successful in his work to the degree in which he has a comprehensive knowledge of the subject.

If the above considerations are correct, the second guiding principle for controlling scientific work of the government is as follows: *The several bureaus engaged in research should be left free to prosecute such research in all its details, without dictation from superior authority in respect to the methods of research to be used.*

I beg to call the attention of the commission to certain statements of the committee of the National academy of sciences, which constitute a part of the record of the proceedings of this commission. These statements are as follows: —

> Your committee states only the general sentiment and wish of men of science when it says that its members believe the time is near when the country will demand the institution of a branch of the executive government devoted especially to the direction and control of all the purely scientific work of the government. In this day the pursuit of science itself is, visibly to all men of education, directly connected with the promotion of the general welfare. . . . The members of your committee are conscious that placing these bureaus under one department would not necessarily result in the proper co-ordination of their work, because the head of such department would probably find it impracticable to enter into the consideration of all details necessary to that purpose. It appears to us that the evils already pointed out require, in any case, the organization of a permanent commission to prescribe a general policy for each of these bureaus. The functions of this commission would be, —
>
> 1°. To examine, improve, and approve the plans of work proposed by the several bureaus, and to revise their estimates in accordance with such plan. The performance of this duty would require consultation with their chiefs, generally and separately, respecting the character of their work; and they should be members of the commission.
>
> 2°. To approve in detail the methods of expenditure of the appropriations.
>
> 3°. To recommend such measures as they deem necessary to the efficiency of the bureaus under their supervision. It should, however, be understood that this commission is not charged with purely administrative responsibility.
>
> It prescribes what shall be done, and recommends any measures necessary to secure that object, but does not concern itself with administrative details.

It will be seen from this extract that the learned members of the national academy constituting that committee, fully recognize the importance of a unified administration of the scientific bureaus. The same committee further expresses the opinion that a department of science is desirable; but, fearing that such a department cannot be organized at the present time, a commission is recommended, to be composed of a secretary of one of the departments of the government, the president of the National academy of sciences, the directors or superintendents of the scientific bureaus, a professor of mathematics from the naval observatory, an officer of the engineer corps, and two citizens of the United States, eminent as scientific men, to be appointed by the president.

Sympathizing fully with the general tenor of the recommendations of the academy, I wish to present certain reasons for objecting to the constitution of the board of commissioners as recommended by that committee. The objection to such a board is twofold. In the first place, it would be composed of incongruous elements. A board composed of civil and military officers would, it is believed, be inharmonious, from the fact that military and civil methods of administration are entirely diverse, and proceed upon diametrically opposed theories. The military officer plans and commands: the civil officer hears, weighs, and decides.

In the second place, the board, as thus recommended, would be impracticable in its relations to the departments under which the several scientific bureaus are placed. Officers subordinate to the secretary of war, and officers subordinate to other secretaries, together with officers having no other connection with the government but as members of this board, would have the practical control of the work, so far as it could properly be controlled; and the secretaries themselves would simply be channels through which instructions to the bureau officers would be transmitted.

This, it is feared, would be irksome to executive officers composing the cabinet of the president. It is a matter of record in the proceedings of this commission, that Professor Newcomb of the navy department, and Gen. Comstock of the army, withdrew from the committee of the national academy at the request of their superior officers, the secretaries of those departments. It is presumable that this action was taken because the military secretaries did not desire to have their subordinates deliberate upon questions of policy affecting the conduct of the secretaries themselves; and this was entirely natural and proper, from a military stand-point, where superior officers plan and command, and inferior officers obey and execute. In a civil department of the government it would have been entirely in the course of things, and in no respect a violation of official proprieties, for subordinate officers to present plans, even of general policy, to their superiors.

Having thus briefly commented upon the plan of the academy committee, I beg permission to suggest a plan which would not involve the same difficulties. There is, in the organization of the general government, an existing body of officers competent to co-ordinate the scientific work, with an organization peculiarly fitted to supervise the general plans, and yet leave the officers of the several scientific bureaus free to carry on the details of operations by scientific methods, as they are developed from time to time. I

refer to the regents of the Smithsonian institution. These regents are composed of the chief justice, the vice-president, three members of the senate, and three members of the house of representatives, and six citizens. These regents are appointed as follows: —

The regents to be selected shall be appointed as follows: the members of the senate, by the president thereof; the members of the house, by the speaker thereof; and the six other persons, by joint resolution of the senate and house of representatives.

This body of regents appoints a secretary of the Smithsonian institution, who is its executive officer. If such of the scientific bureaus as should properly have a civil organization were placed under the direction of the regents of the Smithsonian institution, perhaps the best possible administration of the scientific work of the government would thereby be secured; and the learning and administrative ability of the present secretary of that institution would furnish abundant assurance that the organization of these departments under a common head, would, at its inception, be thorough and wise.

The history of the Smithsonian institution, with its governing board constituted as above, is the best warrant that could be given for a wise administration of the scientific operations of the general government. The first secretary of that institution, Professor Henry, was one of the great scholars of his time; and, under his administration, the affairs of the institution were conducted so as to meet with the approbation alike of the congress of the United States, the learned men of the country, and the people at large. His successor, Professor Baird, one of the leading scholars of the world, has conducted the operations of the institution as assistant secretary, and subsequently as secretary, in such a manner that the government of the United States has intrusted to him much larger and wider duties in the administration of the fish-commission and the national museum. It will thus be seen that the board of regents would constitute an able and efficient supervisory body; and it may always be expected that the executive officer of that board would be a man thoroughly competent to execute such a trust.

I next come to the consideration of the subject as to what bureaus should be placed under this common organization. Two of the bureaus already mentioned are now under the Smithsonian institution; namely, the fish-commission and the national museum. The geological survey could be very properly added to the number. Its relations to the national museum are very intimate. All of its collections of rocks, ores, minerals, and fossils, are deposited therein; and its laboratories for the study of these collections, chemical, physical, and paleontological, are also in the national museum, as they must necessarily be connected with the collections. This relation between the geological survey and the national museum is not by virtue of organic law, but solely by convention between the secretary of the Smithsonian institution, and the director of the geological survey, and is a special courtesy to the geological survey, extended by the secretary of the Smithsonian institution. In like manner the geological survey has intimate relations with the fish-commission. In that commission it is necessary to employ a corps of biologists. The paleontologists of the geological survey also constitute a corps of biologists. The biologists of the fish-commission study the living forms in the existing bodies of water on and around this continent; the biologists of the geological survey study the fossil forms of the same region, some of which still exist, others of which have become extinct; and the biologic work of the two departments is so intimate, that at times the biologists of the fish-commission perform work for the geologists of the survey, and at other times the biologists of the survey perform work for the fish-commission and the national museum. It is very clear, therefore, that the geological survey could appropriately be placed under the same management as the fish-commission and the national museum.

The coast and geodetic survey must first be considered in its relations to certain other departments of scientific work. The committee of the academy recommend the establishment of "a physical observatory to investigate the laws of solar and terrestrial radiation, and their application to meteorology, with such other investigations in exact science as the government might assign to it." And they also recommend that the functions of the bureau of weights and measures, now performed by the coast-survey, be extended so as to include electrical measures, and that the whole be transferred to the new bureau recommended. The coast and geodetic survey already has under its charge the bureau of weights and measures. It is also engaged in magnetic researches, and could appropriately undertake electrical researches, and also the researches relating to solar and terrestrial radiation. I do not think that it would be best to create a new organization for the purposes thus indicated, but that it would be the part of wisdom to enlarge the functions of the present organization of the coast and geodetic survey to accomplish the desired purpose.

I have already mentioned that the national observatory is one of the institutions engaged in original research of such a character that it should form one of the co-ordinated bureaus, but it would not be necessary to transfer it as an independent bureau. It might properly be consolidated with the coast and geodetic survey. Under such a plan, this survey would have for its functions geodetic investigations, the methods of which are in part astronomical. It would also have the gravity investigations, and the investigations relating to solar and terrestrial radiation, which are also in part astronomical. It would also have the magnetic and electrical investigations. All of these lines of research are intimately related and profoundly interdependent.

I come now to a consideration of the survey of the immediate coast of the United States. The primary purpose of this survey is the construction of charts to be used by mariners. This survey of the coast

proper is nearly completed, and should be finished by the present organization. When thus finished, the work of the coast-survey on land will be practically ended, but the hydrographic operations must be permanently continued. In this hydrographic work a large corps of naval officers and seamen are employed under the coast-survey; and the navy is also engaged, under the organization of the hydrographic bureau, in conducting researches of like and related character off the coast. It is evident that this hydrographic work prosecuted by the coast and geodetic survey is pre-eminently a naval work, from the fact that officers and seamen of the navy are employed in its prosecution. The officers of the navy are necessarily, and should be, the geographers of the sea. Statesmen agree, that, even in time of peace, a naval establishment must be maintained. A school is supported by the general government for the education and training of officers to command its navies. This training should be continued by practical operations at sea, not by engaging in unnecessary war, but in the navigation of the seas and the management of vessels; and, while thus engaged, the navy may be appropriately and economically employed in the study of oceanic geography. I am therefore clearly of the opinion that the hydrographic work of the coast and geodetic survey should be transferred to the hydrographic bureau of the navy. As thus organized, it would necessarily have a military administration, and could not properly be placed with the other scientific bureaus enumerated above under one common management. There would yet necessarily be relations existing between the bureau of navigation and the other scientific bureaus; but they would be of a much less fundamental character, and would be limited in scope, and the few relations thus existing could be properly adjusted by convention.

If the signal-service is to have a military organization, it would be unwise to directly associate it with bureaus with civil organizations, for reasons already stated. Should it be deemed wise to include it in the group of scientific institutions, it should then be reorganized on a civil basis.

The various lines of research enumerated in characterizing the scientific bureaus above are such as properly pertain to the functions of government in the common judgment of mankind. The warrant for this statement exists in the fact that the leading civilized governments of the world do, in fact, provide for the prosecution of such operations. The subject of the endowment of such research by government has been widely discussed by statesmen and by scholars in America and in Europe alike; and the wisdom of such endowment, and the fundamental principles that should control such work, have been again and again clearly enunciated. The actual practice of the several governments engaged in this work is to a large extent harmonious, but in some important particulars there is diversity of methods. In the British government a part of the scientific research is controlled by organizations in the executive departments: another part is controlled by scientific societies organized under royal charters, and receiving grants of money from the general government. In the German states various methods are adopted, one of the most important of which is that the universities receive grants from the general government for scientific research. This latter method largely prevails in Russia; but in all of these countries the methods adopted in the United States are steadily gaining ground, and the practice of European governments is steadily following the precedents established in the United States.

The questions submitted by act of congress to the deliberation of this commission affect profoundly all of the important industries of the land. You are to decide for the people the best methods of utilizing the results of all scientific research, as they pertain to the welfare of the people of the United States; and your action, should it be confirmed by congress, will ultimately affect the deepest interests of all the people; and the influence of your action will be exercised in promoting or retarding scientific research itself, which is the chief agency of civilization, and the results of which constitute the chief elements of civilization.

THE AMERICAN SOCIETY FOR PSYCHICAL RESEARCH.

AT a meeting held in Boston, Jan. 8, the organization of the society was completed. The conduct of the affairs of the society is by the constitution placed in the hands of a council of twenty-one, which consists of Prof. G. Stanley Hall of Baltimore; Mr. George S. Fullerton of Philadelphia; Dr. William James, Prof. E. C. Pickering, Prof. J. M. Peirce, of Cambridge; Mr. Coleman Sellars of Philadelphia; Major A. A. Woodhull of New York; Professor Simon Newcomb of Washington; Drs. C. S. Minot and H. P. Bowditch, and Messrs. W. H. Pickering and C. C. Jackson, of Boston; Col. T. W. Higginson and Mr. N. D. C. Hodges, of Cambridge; Prof. George F. Barker of Philadelphia; Mr. S. H. Scudder and Prof. C. C. Everett, of Cambridge; Mr. Morefield Storey of Boston; Professor John Trowbridge of Cambridge; Mr. William Watson of Boston; and Professor Alpheus Hyatt of Cambridge. Professor Newcomb has been chosen by the council as president of the society, and Profs. Hal, Fullerton, E. C. Pickering and Drs. Bowditch and Minot, as vice-presidents; Mr. Watson, treasurer; and Mr. N. D. C. Hodges, secretary.

After the organization was completed, Professor Pickering, who was in the chair, referred briefly to the work of the committee on organization, which has had the matter in charge since last fall, and said that the details of organization would bear a small part in the work of the society; that there was now need of co-operation among all members in order that there might be some fruitful investigations carried on. He urged all members to look about among their friends for suitable subjects; Professor Pickering's opinion being that it would be much safer and more satisfactory to experiment on people of good standing, who might exhibit powers of mind-reading, or

might be good subjects for hypnotic experiments, rather than employ the professionals, many of whom are doubtless tricksters. He referred to the wide interest which is exhibited now throughout the whole world in the prosecution of psychical research.

The committee on work, or suggestions as to possible work, stated that they had sent out circulars to the members of the society, calling for volunteers as members of the investigating committees; that they had received a number of answers; that the most of them were from those specially interested in thought-transference; and they recommended the appointment of a committee on that subject. They also suggested that a circular should be issued by the society, describing the methods of making experiments in thought-transference, and pointing out the precautions to be taken. Such a committee has been appointed by the council, and will in a short time issue its circular, and commence work. It is thought best, that, in order to confine as far as possible the possibility of guessing correctly what is in a person's mind by mere chance, the object thought of should not be too simple; that is, if it is a figure, it should not be a circle, or a square, or harp-shaped. A word was suggested as a suitable thing to think of, or any one of the digits from one to ten.

There was a lengthy discussion, in which Drs. Minot and Bowditch, Professor Pickering, Col. Higginson, Dr. James, and others, took part. Many of the speakers advocated the employment of professionals, saying that it was nearly impossible, with many would-be honest mind-readers, to tell where their real power ended, and where fraud began. It was stated that some of the professionals confess that at times they eked out their powers with a mild deceit. It was felt by many that in testing professionals there would not be any feeling of restraint about using precautions against fraud; that it would be perfectly understood that all means for getting at the truth could rightfully and properly be employed.

For the present the work of the society will be confined largely to experiments on thought-transference. The committee on work hesitates to recommend to the members at large investigations in hypnotism, on account of the danger which would arise when they were carried on by inexperienced hands.

SOME RECENT EXPERIMENTS WITH OIL IN STOPPING BREAKERS.[1]

THE U. S. hydrographic office, in pursuance of its policy to lessen the dangers of navigation, has recently commenced the collection of information to determine the best manner of using oil to calm the surface of troubled waters.

This matter has long been a subject of controversy. In 1844 a Dutch commission, after pouring a few gallons of oil on the storm-beaten bosom of the North Sea, and finding the waves not sensibly affected declared that the oft-repeated account of the saving of ships by this means was a fantastic creation of the imagination. Notwithstanding this, Scotch coasters have saved themselves again and again by strewing the sea with the fatty parts of fish, cut into small pieces, which were carried with them for the purpose; and so much reliable information on this subject has now been collected from the common experience of seafaring men, that the evidence in its favor can no longer be controverted.

It must be understood, however, that the use of oil does not make the surface perfectly smooth, but merely lessens the dangerous effect of what the seaman calls 'combers,' or the great broken, rolling masses of water which have first disabled and then swamped so many ships since man first began to go down to the sea.

A case lately reported of the use of oil is that of the steamship Thomas Melville, while running before a gale in February, 1884, when she was constantly boarded by heavy seas. As her situation became more and more critical, it was determined to try what effect oil would have upon the water. Two canvas bags holding about a gallon were made, therefore, punctured in many places with a sail-needle, and filled with oil. These bags were hung over the bows, and allowed to drag in the water. The seas no longer came on board, and the safety of the vessel was secured. The bags were refilled every four hours.

The application of oil to the quieting of water at the entrances of harbors is one that has received very considerable attention; and credit is due to Messrs. Shields and Gordon of England for their energy and enterprise, as well as for the thought, time, and money expended in endeavoring to establish its use, and in bringing the subject into prominent notice.

At Folkestone, Eng., Mr. Shields's apparatus consisted of three large casks placed on shore at the end of the old mole. These were connected by pipes with small hand-pumps, each of which was worked by one man. Two lead pipes about an inch and a quarter in diameter extended from the casks along the bottom, through the entrance to the harbor, about 2,950 feet toward's Shakespeare's Cliff. At intervals of every hundred feet, vertical pipes were soldered to the main pipes; and in the former were placed conical valves properly protected from mud and slime by caps.

Unfortunately, on the day set apart for a public exhibition the weather was not entirely favorable; that is to say, the wind was not from the right direction. The sea, however, was sufficiently disturbed to show the working of the apparatus. When the oil was pumped through the tubes, it soon showed its effect upon the surface; and this became more apparent as the amount of oil was increased.

A broad glassy strip was soon distinguished which was more than a half-mile long. A fully manned lifeboat, which was sent into the oil-covered strips of water, was tossed about in a lively manner, but took in no spray. Meanwhile the sea outside of the strip was everywhere breaking into white caps. After

[1] Communicated by Capt. J. R. Bartlett, chief hydrographer of the navy.

stopping the pumps, it was found that the amount of oil used was a little over a hundred and nineteen gallons.

Three hours after the close of the trial, the Boulogne steamer passed broad strips of comparatively smooth water, on which the oil still lay.

After this experiment, two of Mr. Gordon's inventions were tried. One of these consists of a shell fired from a mortar, and so arranged that it bursts on striking the water, and frees its contents of oil. The shell is specially constructed, and has an ingenious device for insuring its explosion, which is effected by a fuze and gunpowder. This recommends itself as a practical means to render less dangerous the communication between ships by boats during heavy weather. In case of shipwreck, also, the approach of lifeboats could be greatly facilitated.

The second invention is an arrangement to make a lane of oil from the shore to a stranded ship. To effect this, an iron cylinder is fired from a mortar in the direction of the ship. The cylinder, which serves as an anchor, draws after it a leather hose fastened to it by a line. Oil is then pumped through the hose, and, being spread towards the shore by the wind, forms a quiet surface for the rescuing boat.

Various ingenious contrivances have been invented for applying the oil to the water; but the simplest and readiest, at the same time most effective, appliance is a canvas bag, either rather loosely sewed together, or pierced with small holes to allow the oil to escape. This has been the method adopted in the most successful cases reported from ships at sea, and has been found effectual in some of the lifeboats. It has the great advantage of being self-acting, insuring a regular stream of oil, and being easily renewed when exhausted.

In a vessel or boat running before a sea, one should be hung over each bow, which gives the oil time to spread before reaching far astern. In a ship, when hove to, one or more bags have sometimes been hung over the weather side, and sometimes been put overboard to windward, attached to light lines. This is the best plan, because, not drifting so fast as the ship, the bag will be carried to windward, and fulfil the condition of applying the oil to the water at some distance from the ship, in the direction from which the waves are advancing.

An open boat, unable to run before the sea, will always endeavor to put out some form of sea-anchor, with a rope attached to it: the bag of oil should be attached to this, and, failing every thing else, a boat's mast or a sail loosed is very effective.

When the boat is anchored, the bag could be attached by a light line to the anchor as a buoy. This appliance, in addition to being efficient, has the great merits of handiness and simplicity. Two such bags, holding about a gallon of oil each, with the line attached, might be kept full, and packed in a small cylinder similar to a paint-pot or a preserved-meat tin, and would form neither an expensive nor cumbersome article of equipment in a boat.

In the absence of these or similar contrivances, the oil could be poured from a bottle or can; but this would require a man's attention when one could be ill spared possibly, and might not insure so constant or regular a supply, which is of importance. This would not be applicable to a boat at anchor.

REPORT OF THE SUPERINTENDENT OF THE U. S. NAVAL OBSERVATORY.

THE report of Commodore S. R. Franklin, who succeeded Admiral Shufeldt as superintendent of the observatory on Feb. 21, gives, under date of Oct. 29, 1884, a summary of the work accomplished during the year. In organization a slight change has taken place by the appointment (by the superintendent) of a board consisting of the superintendent, the senior professor of mathematics, and the senior line-officer, to determine the scope and character of the work to be done. The board may be convened at the request of any member, and a weekly report is submitted to the superintendent every Monday by each officer in charge of an instrument.

The twenty-six inch equatorial, in charge of Professor Hall, has been employed mainly in observations of the satellites of Neptune, Uranus, Saturn, and Mars, and of double stars, with a few observations for stellar parallax. In the case of Uranus, the observations were confined mostly to the outer satellites; and it is proposed now to discontinue them, since the favorable time for determining the position of the orbit planes of these satellites has passed. The reductions are all well advanced.

The transit circle has been under the charge of Prof. J. R. Eastman, and has been employed in observations of the sun, moon, planets, comets, and a catalogue of miscellaneous stars, as in previous years. The nine-inch equatorial, in charge of Commander Sampson, has been used in observing comets, minor planets, and occultations. The series of observations with the prime vertical instrument was practically finished in May, 1884. The reductions are being carried on by Ensign Taylor. The meridian transit instrument has been used primarily to determine clock corrections, in connection with the daily time-service. Observations for the right ascensions of the sun, moon, and major planets, have also been made.

The time-service has been considerably extended. In addition to the lines already existing, the Baltimore and Ohio telegraph company looped two of its main circuits into the observatory, and the signal-service looped one. In March last a proposition was submitted to the heads of the several departments in Washington, to place in the more important offices of the government, including the executive mansion and the capitol, a clock that should be regulated and controlled every day from the observatory, which establishment should be responsible for the determination and transmission of correct time. This plan met with general approval; and an insulated circuit was established connecting the various offices, some twenty in number, with the observatory. In each

of these offices is a clock which is corrected daily, at noon of standard time, by means of an automatic attachment (the invention of Mr. W. F. Gardner, the instrument-maker of the observatory), actuated by the current which makes the signal for dropping the time-ball at the observatory, and on the Western union telegraph company's building in New York.

In the publication of its annual volumes, the observatory has been much embarrassed, owing to the limited amount of the printing-fund of the department. The volume for 1880, which it was expected would be ready by the 1st of January, was not received until October; and the computations, even with the small working force available, have been carried much beyond the printing.

In regard to the proposed new observatory, the superintendent says, —

"I cannot too earnestly urge upon the bureau the necessity of commencing the buildings for the new observatory. The ground having been purchased, and the plans made and approved, there seems to be no good reason why the construction should not begin. The present site is notoriously unhealthy, and the buildings are dilapidated and much in want of repair; and it would not be in the interest of economy to make any extensive repairs while the erection of new buildings is in contemplation. The delay is very prejudicial to this establishment in particular, and to the cause of science in general. I respectfully request, that, if all the money cannot be appropriated for the purpose aforesaid at the coming session of congress, a portion of it, at least, may be asked for, in order that this work, now so long delayed, may be begun."

An estimate of $586,138 is submitted for erecting the necessary buildings.

An appendix contains a report by Professor William Harkness, showing the progress made in the reduction of the transit of Venus observations. The photographic negatives (over fifteen hundred) have all been measured, and very considerable progress has been made in the computations necessary for the reduction of these measurements. An extended investigation is now being made of the focal lengths of the photographic objectives, and the radii of curvature of the heliostat mirrors.

BANDELIER'S ARCHEOLOGICAL TOUR IN MEXICO.

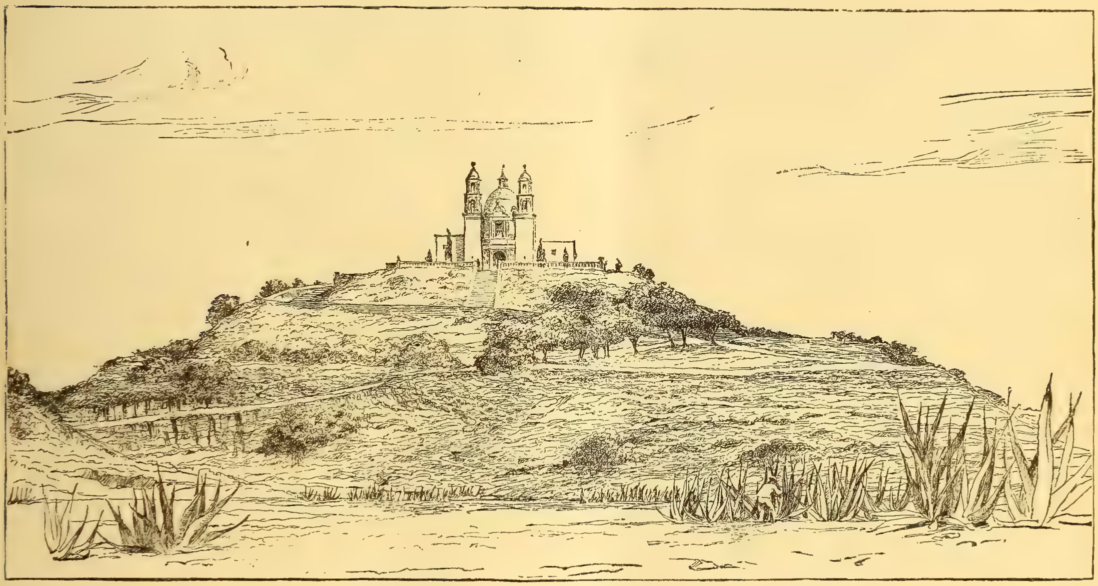
The author of the report before us is well known in New-England archeological circles, having won for himself a fair name through the publication of three essays, — on the art of war and mode of warfare, the distribution and tenure of land, and the social organization and mode of government, in ancient Mexico. In consequence of these scholarly discussions, the archeological institute, in 1880, commissioned Mr. Bandelier to investigate the condition of the sedentary Indians of New Mexico, and in 1881 a second time commissioned him to carry out an archeologic exploring-tour through Mexico proper. The report under consideration, profusely illustrated, and numbering three hundred and twenty-six pages, gives a full account of the results of Mr. Bandelier's studious researches on his second expedition.

Report on an archeological tour in Mexico, 1881. By Adolph F. Bandelier. Boston, 1884. Published in Papers of the Archaeological institute of America. Series II.

The account, it seems to us, has assumed rather the form of a scientific narrative than that of an official report made to a committee. The author was able to draw upon an immense stock of preparatory studies; and, accustomed to look at ancient Mexico through the spectacles of the chroniclers, the objects that strike his eye at each step on the classic soil remind him of some passage read, the true meaning of which he now strives to detect, with the help of ocular inspection and learned reasoning. Thus, also, the grandeur of the surrounding scenery invites him to give us data of hypsometry and meteorology, of vegetation and interesting culture-plants. He compares statistics of old with those of the present time, and cautiously avoids entering into controversy with the theories urged by other scholars or non-scholars to solve the origin of the mysterious temple and palace builders of Mexico. To be brief, by a very adroit interspersion into his text of nicely presented scientific *causeries*, Mr. Bandelier, it appears to us, may have secured for himself a larger number of readers than if he had chosen to offer a compact and matter-of-fact report.

The text is divided into four chapters. In the first chapter the author, reposing on a steamer's deck, calls us to his side, and, pointing toward the vast main, allows us to partake of the rich stock of his reminiscences. He tells us of the legends hovering around the ancient province of Huasteca, its forest-buried cities, the colossal structures of Papantla and Misantla, and deplores the fact that a thorough exploration of these hitherto but vaguely described ruins is beyond the limits of his mission. On his road from Vera Cruz to the capital, he engages in discussions on the *étapes* once taken by Mexico's first conqueror, the natural and artificial obstructions that Cortez met with, and the allies he was so fortunate as to secure in the Indians of Tlascala. After Mr. Bandelier's arrival in the capital, he very judiciously sets forth to acquaint himself with the best authorities in Mexican archeology. He takes their advice and suggestions, carefully examines the objects of antiquity preserved in the museum, and collects valuable data on the former expanse and limits of the renowned lagoons, and the modern efforts made for their regulation and draining (pp. 49–78). In the third chapter, Mr. Bandelier's independent and main work is given. It bears testimony to the most thorough exploration ever made of the often-described pyramid of Cholula, its structure, appendages, and surroundings. No hewn stone, no sculpture, no masonry or mound, remains unexamined; and no hint picked up from ancient reports, if serving his purposes of reconstruction, is slighted, but dexterously employed to give fuller shape and brighter color to the picture we are wont to form of the once stately and now decaying fabric. He succeeds, finally, in showing that in former times the giant pyramid did not stand isolated, but east and west of it were two companions, considerably smaller, however, and of the well-known teocalli-shape,

truncated, and with staircases, like the pyramid itself. As to the material of which the latter was constructed, Mr. Bandelier arrives at the conclusions of A. v. Humboldt and his successors; i.e., that it was built of large sun-dried adobes. Burnt lime for coating or for mortar, Mr. Bandelier discovers, was never employed by the Indians; pulverized limestone being prepared for the purpose. No shaft has as yet been sunk in order to ascertain whether the interior of the pyramid is of the same material as the exterior, or whether the structure was made around a natural mound, or whether it is hollow, and possibly contains some sepulchral vault of historic importance. According to tradition, the platform was crowned with a temple, in which Quetzalcohuatl, the god of air, was worshipped. The current opinions about this mysterious being are learnedly discussed.



THE GREAT MOUND AT CHOLULA.[1]

From Cholula the traveller directs his steps southward, and visits the valleys of Oaxaca, the famous ruins of Monte Alban, Xagá, Mitla, and others. Vivid description is given of all of them, copious and careful measurements secured, and sketches as well as illustrations presented, of hitherto unobserved details.

Did Mr. Bandelier, as we presume, set forth on his exploring tour inspired by the hope of detecting in the architectural remains of Mexico proper such elements as would tend to prove these remains to represent some final stage of tectonic development, of which the initial stage must be sought in what he calls the 'tenement houses' of the sedentary Indians in New Mexico, he must have felt somewhat disappointed with the result of his investigation. We are of the positive opinion, that if in plan, as well as in execution, he had met in Mexico's architecture any traces pointing either to an intimate or only to a remote historic connection with the window-houses of the Indians of the north, he would have exulted over such discovery, and have expounded its adaptation to a certain theory that was advanced by the late Lewis H. Morgan, whom Mr. Bandelier looks up to as to a beloved teacher and friend. Not to have yielded to the temptations of a pre-occupied mind is a merit which deserves full and fair acknowledgment. It shows the faithfulness of Mr. Bandelier's observation and the conscientiousness which he brought to bear on the fulfilment of his scientific task.

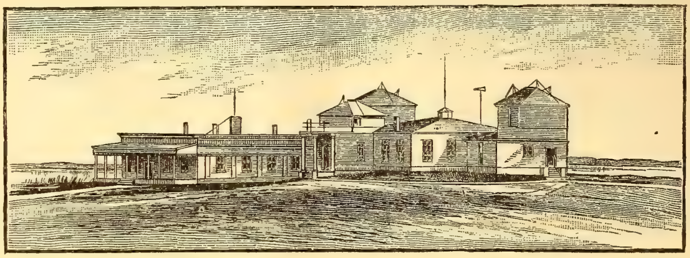
[1] Reproduced by permission of the Archaeological institute.

THE ARGENTINE ZONE CATALOGUE.

THE work for which Dr. Gould went to South America fourteen years ago, as astronomer to the Argentine Republic, is at last completed, and both the zone-lists and the star-catalogue compiled from them are published. It is not for us in a non-technical journal to discuss the purely astronomical value and accuracy of such a work, but rather, in announcing it, to recall to the contemporaries of this eminent astronomer, and bring to the attention of the younger men, — who have, even during the long progress of the work, attained an age at which they may appreciate it, — this monument of patient determination, executed under trials that might well be termed privation, exile, and affliction. During the disheartening delays in constructing the observatory and mounting the instruments, the 'Uranometria argentina,' a worthy

Zone catalogue. Mean positions for 1875.0 of the stars observed in the zones at the Argentine National observatory. By BENJAMIN APTHORP GOULD. Cordoba, 1884. 2 v. 4°.

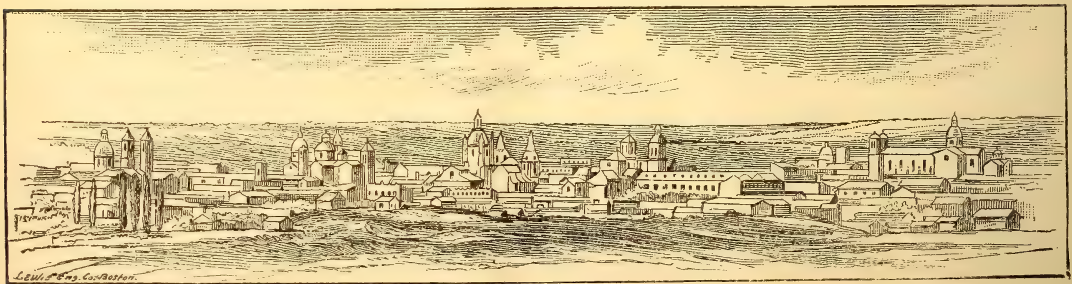
complement to Argelander's 'Uranometria nova' of the northern sky, was undertaken, and carried well toward completion, and published with star-charts in 1879, giving the estimated brightness of all southern stars, visible without telescopic aid, in about seventy grades of brilliancy. The observations for this work were made by the naked eye, or with ordinary binocular field-glasses, and entirely by the assistants; Dr. Gould's near-sightedness preventing his sharing immediately in the work, although he directed and overlooked its execution with the most minute carefulness. The zone observations, by which astronomers understand the determination of the position of stars observed in successive belts around the sky, every star being noted as it crosses the field of a meridian-circle telescope, were begun in August, 1872, and completed in 1875. In these, every one of the original telescopic observations was made by Dr. Gould; and they numbered over 105,000. Since 1875 the work of computation, revision, and publication, has occupied eight years, until now the finished catalogue is before us; and Dr. Gould may proudly feel his ambition satisfied in ending so well the work begun in outline by Lacaille with his little telescope at the Cape of Good Hope over one hundred years ago.



DR. GOULD'S OBSERVATORY AT CORDOBA.

Among the younger men who have shared in Dr. Gould's labors at Cordoba, only one has remained with him through the many years since its beginning. We feel sure from the frequent mention, in the annals of the observatory, of the faithful services of Mr. John M. Thome, that the director will gladly see the name of this assistant associated with his own in our brief notice of the work they have accomplished together.

The first of the accompanying cuts, reproduced from sketches by a former assistant, shows the observatory and the director's house on the *barranca*, from which the second view, of Cordoba in the valley of the Rio Primero, is taken. The overshadowing of the town by the churches is characteristic of the place.



VIEW OF CORDOBA FROM DR. GOULD'S OBSERVATORY.

NOTES AND NEWS.

IN ACCORDANCE with a recommendation of the recent geodetic conference, a series of observations for latitude is to be made at the U. S. naval observatory, which, taken in connection with a similar series made elsewhere, and compared with observations made after an interval of some years, will assist in determining whether there are any slow changes taking place in latitudes upon the earth. Lisbon, which is very near the same parallel as Washington, is expected to co-operate with the naval observatory. The observations will be made with the prime vertical instrument; and at Washington a line-officer of the navy will be detailed for the work, which will probably require several years.

—Prof. F. H. Snow of the University of Kansas reports that only two Decembers (in 1872 and 1876) in the past seventeen years were colder than that just passed. It was the cloudiest December upon record, and the precipitation of rain and snow was more than fifty per cent above the average. Ice formed upon the Kaw River to the thickness of thirteen inches.

—The fifteenth annual meeting of the Wisconsin academy of sciences, held at Madison from Dec. 29 to Dec. 31, was unusually well attended. The academy expects to have suitable rooms assigned it in the capitol, on the completion of the additions to that building, in which its library and collections can be properly placed. The latter has become doubly valuable since the destruction of the scientific collections of the

state university, as it contains the only complete set of the Wisconsin rocks and fossils collected by the State geological survey. The sixth volume of the Transactions of the academy is nearly through the press, and will soon be distributed.

— The 'stately procession' of quarto volumes issuing from the census office has recently been increased by the addition of vols. ix. and x. The former consists of the report of Prof. C. S. Sargent upon the forests of North America (exclusive of Mexico). The six hundred and twelve pages of the report are divided into three parts. Part i., relating to forest-trees, sketches the general distribution of forests and of arborescent species and genera, while the great bulk of the chapter is devoted to an exhaustive descriptive catalogue of the forest-trees of the region. Part ii. treats of the economic qualities of the principal woods, their specific gravity, fuel value, strength, etc. Part iii. is devoted to the lumber industry, treating incidentally, also, of many minor points connected more or less directly therewith, such as forest-fires, the pasturage of woodlands, etc. The maps in the report, of which there are no less than thirty-nine, illustrate the different degrees of density of the distribution of woodland, the distribution of merchantable timber, and the areas deforested, the extent of forest-fires during the census year, and the character of the fuel used in various parts of the country. The report is accompanied by an atlas of cumbrous size, containing thirteen maps of the United States and of North America, illustrating the distribution of forests in general, and of a number of genera of forest-trees; showing the position of forest, prairie, and treeless regions, and the natural divisions of the North-American forests. Vol. x. contains three monographs bound together: 1°, 'On the production, technology, and uses of petroleum and its products,' by Prof. S. F. Peckham; 2°, 'The manufacture of coke,' by J. D. Weeks; and, 3°, 'Building-stones of the United States, and statistics of the quarry industry,' by George W. Hawes *et al.* The report upon petroleum is exceedingly full, comprising three hundred and one pages, illustrated by numerous cuts and maps. It is divided into three parts, the first of which relates to the history of the subject, the geology, geography, and chemistry of petroleum, and contains the statistics of production. The second is devoted to the technology of petroleum, and the third to its products and uses. The report upon coke (a hundred and fourteen pages) opens with the statistics of the industry, followed by descriptive matter relating to its extent and importance in the United States and in foreign countries, and closes with the chemistry and technology of the subject. The report is illustrated by numerous cuts. The report upon quarries and building-stones (four hundred and ten pages) opens with a discussion of general matters pertaining to the subject, followed by chapters upon microscopic structure and chemical composition of building-stones, and the methods used in quarrying. The statistics of the industry follow, accompanied by detailed descriptions of quarry regions. The succeeding chapter is devoted to the extent of stone-construction in the leading cities, in the course of which is found an admirable article upon stone-construction in New-York City, by Prof. A. A. Julien. This well-known authority makes a further contribution to the report in the form of a chapter upon the durability of building-stones in New-York City. The work is illustrated with eighteen heliotype plates from microscopic photographs of rock-slides, and thirty-two chromo-lithographs (by Bien & Co.) of polished rock-surfaces. These are among the finest specimens of the lithographic art which have yet been produced in this country.

— The bark Helen Isabel recently arrived at St. John, N.F. While in latitude 38° 51′ north, longitude 29° 55′ west, Dec. 18, a terrific earthquake was experienced, lasting fifteen minutes. The submarine roaring was appalling, and the vessel was shaken in every fibre. The weather was calm and fine at the time. This is of interest in connection with the recent earthquakes in Spain.

— The commander of the British steamship Bulgarian reports that on Dec. 29, in latitude 49° north, longitude 34° 30′ west, at two P.M., while the sea was smooth and the wind moderate from south and west, he ran through a regular bore. The water boiled and seethed. The surface of the bore was about two feet above the general level of the ocean, and its extent about six miles long and from three to five miles wide, moving to the north-east. This is a very unusual phenomenon for such a place.

— In a report by the committee on the metric system of weights and measures, of the Boston society of civil engineers, attention is called to a number of instances in which the metric system is now used in this country. A number of makers of surveyors' tapes now graduate them on the metric system, as well as in feet and inches. About the only case reported of the introduction of the system for trade purposes is that of the Minneapolis flour-mills, which put up flour in bags containing fifty and a hundred kilos, for export to Europe.

— A *Journal of mycology* is announced by W. A. Kellerman of Manhattan, Kan., under the charge of J. B. Ellis of Newfield, N.J., and W. A. Kellerman, as editors. It is proposed to make the journal a monthly of from twelve to fifteen pages. It is to be hoped that the undertaking may prove successful; but it is very doubtful whether there can be need for so special a journal, when we consider that it will be supported solely by American students.

— We have received a copy of an interesting statistical pamphlet, "Die stundenpläne für gymnasien, realgymnasien und lateinlose realschulen in den bedeutendsten staaten Deutschlands, zusammengestellt von G. Uhlig" (Heidelberg, *Winter*, 1884). The tabular views of each group of schools are first separately given; summaries compare in tables the number of hours given to each topic in the schools of the various states of the German empire; and seventeen closely printed pages of *resultate* discuss these statistics with great completeness, and yet with great condensation. It will be seen that we have here an

excellent means for finding what topics German schools of the various classes actually teach, and how much they teach of each topic to pupils of any given age. The accuracy of the pamphlet is vouched for by competent authority; and the whole may be warmly commended to every one who is engaged in the study of problems connected with elementary education. The general reader, also, will be interested in the suggestions that he can get at a glance from these tables concerning the character of German elementary education. Quotation is, on the whole, hardly possible where a book is already a model of condensation, and we shall not attempt it. But let no one pretend hereafter to pass judgment on the work of German schools without using the elementary facts as they are here presented.

— The Anthropological society of Washington has adopted the plan of so arranging its programme as to devote an entire evening to a single subject, or to subjects closely related. This adds much to the interest of meetings. The place of meeting in Columbian university building is convenient, and the attendance has lately been larger than ever before in the history of the society. On Jan. 20 is the annual election of officers.

— Sir William Thomson's lectures on molecular dynamics are now ready for delivery to subscribers. An edition of three hundred copies has been printed, and of these only seventy-five remain for sale. The volume contains three hundred and thirty-six pages in all. Sir William Thomson has sent, since his return to Europe, several pages of additional matter, which is given with the lectures. An index and bibliographical note have also been added.

— In a speech before the African conference at Berlin last November, Mr. Stanley, according to *Le mouvement géographique*, said, "The Kongo is, with one exception, the greatest river in the world, with the most extensive valley. No region, either equatorial or tropical, can rival it in fertility. There are great empires of natives, and republics, such as Uganda, Ruanda, Unyoro; a country of broad plains for the grazing of cattle, as the Masai Land. There are numerous deposits of gold and silver, and rich mines of copper and of iron. There are beautiful forests which produce woods of an inestimable value, India-rubber in inexhaustible quantities, gums, and precious spices. There pepper and coffee are grown. There are tribes susceptible of appreciating the advantages of civilization, provided they are protected against the attacks of brigands and the ambuscade of the slave-trader. In my opinion, these facts are sufficient to justify my proposition to define, by means of the easily ascertained limits I have proposed, the frontiers of the free commercial territory of equatorial Africa, and to guarantee the freest possible access as well from the east as from the west."

— The advice to explore the high peaks and little-known parts of the Caucasus, given to experienced Alpine travellers in the early part of the year, by D. W. Freshfield, in the *Alpine journal*, has already borne some fruit. The well-known Hungarian mountaineer, Moritz v. Déchey, was the first on the ground. On the 24th of July, he, in company with two Swiss guides, made the first ascent of the 15,500-feet-high peak of Adni Choch, after overcoming great difficulties. On the 23d of August followed the ascent of the highest western peak of the Elbrus, which had been previously accomplished but once, — by Grove in 1874. During the journey, which led from the Arden valley, over the high passes of the Elbrus, photographs and measures of elevation, which have hitherto been entirely wanting from the central Caucasus, were taken.

— Dr. Brieger of Berlin has made a special study of the ptomaines; i.e., the chemical poisons resulting from the action of bacteria upon animal substances. By digestion of albuminous bodies in gastric juice, he obtained a toxic substance, to which he has given the name peptotoxin. From putrid flesh he obtained two bodies, — one a diamin of the composition $C_5H_{14}N_2$, a body which he calls neuridin, which, when pure, is devoid of toxic action; and, as the second product, neurin, a substance with decided poisonous properties, antagonized by atropin. By the putrefaction of fish-flesh, another diamin was discovered, ethylendiamin, — $C_2H_4(NH_2)_2H_2O$, — a powerful poison; also muscarin, and a body which Brieger provisionally calls gadinin ($C_7H_{17}NO_2$). It is interesting to note that the character of the ptomaines formed, depends somewhat upon the character of the material used: thus, neurin is found only in the putrefaction of flesh; while muscarin, ethylendiamin, gadinin, and triethylamin are specific products of fish putrefaction, and dimethylamin of gelatin putrefaction. His work also indicates that the ptomaines should be divided into the poisonous and non-poisonous.

— The *Journal of the Society for psychical research* for November (for circulation among members only) contains an interesting account of Professor Barrett's visit to America, and the steps which led to the formation of an American society of similar name. Professors Bowditch, Fullerton, Stanley Hall, James, Carvill Lewis, and Pickering have been chosen corresponding members of the London society.

— Among recent deaths we note the following: Hermann Kolbe, professor of chemistry at Leipzig, Nov. 26, at the age of sixty-six; Dr. Heinrich Bodinus, director of the Berlin zoölogical gardens, at Berlin, Nov. 23, at the age of seventy-one; Dr. Karl von Vierordt, at Tübingen, Nov. 22, at the age of sixty-seven; Henri Lortique; A. W. Thienemann at Zangenberg, Nov. 5, at the age of fifty-four; Alfred Brehm, at Renthendorf, Nov. 11, at the age of fifty-five; Professor Edmund Tömösvary, at Deva, Aug. 18; Charles Tulasne, at Hyères, Aug. 21, at the age of sixty-eight; Richard Townsend, professor of mathematics at Dublin university; Arthur Henninger, chemist, at Paris, in November; Dr. Thomas Wright, at Cheltenham, Nov. 17; Dr. W. von Wittich of the University of Konigsberg, Nov. 21; Henry Lawrence Eustis, professor of engineering at Cambridge, Mass., Jan. 11, in his sixty-sixth year.

SCIENCE.

FRIDAY, JANUARY 23, 1885.

COMMENT AND CRITICISM.

Dr. E. Ray Lankester writes to *Nature* of Dec. 25 a letter denouncing Koch's claims in regard to the cholera bacillus, and denying his right to any more knowledge in regard to bacteria "than that which an industrious worker may be expected to have gained in the course of very special observations in regard to a limited class of these organisms (the pathogenic class), extending over a few years." Fortunately, Koch's reputation rests upon a more solid foundation than that which is conceded to him by some English and American writers, and his work is not likely to lose any of its value by accusations of want of knowledge. The writer in *Nature* gives a very distorted diagram of various organisms, — the bacillus of glanders, the bacillus subtilis, etc., — and lays especial stress upon the fact that Koch said nothing of the comma bacillus before reaching India, and that in Egypt an entirely distinct and straight organism was claimed as the cause of cholera. This is a distinct accusation, which does not seem to us to be justified by Koch's reports. Whilst in Egypt, the German commission found several organisms, one of which might be the specific cause of the disease; but no actual proof of the fact was offered or suggested. It was because they were in doubt, that they asked permission to carry on their investigations in India; and it was only after they had reached that country, and had had opportunities for further investigation, that special stress was laid upon the comma bacillus. The case, so far as Koch is concerned, is summed up in our columns of Dec. 19, 1884. His opponents might well choose an advocate less biassed than Dr. Lankester. The *disproval* of Koch's theories must come from actual work upon the subject, and not from literary efforts.

Later reports of the work of Drs. Klein and Gibbes (the English cholera commission) in India justify their conclusions more than what we had seen when speaking of it last week. Their results are summed up in the *Gazette of India* for Nov. 28, 1884 (*Lancet*, Jan. 3, 1885), and are as follows: 1°. They find 'comma bacilli,' so called, in other diseases than cholera, as epidemic diarrhoea, dysentery, and intestinal catarrh, associated with phthisis. 2°. They did not find the comma bacilli in typical cases of cholera in any thing like the numbers claimed by Koch: they never approached the appearance of a 'pure culture' in the ileum. 3°. They did not find the comma bacilli in the tissues of the intestines, or elsewhere, as Koch did. 4°. Klein was unable to discover that the comma bacilli differed from any other putrefactive organism under cultivation. 5°. They found peculiar-shaped bacilli, very small and straight, in the mucus-corpuscles found in mucus-flakes removed from the intestine soon after death from cholera: they found these same bacilli always, even when the comma bacilli were not discovered. 6°. These bacilli do not behave in any peculiar way under cultivation, and are not to be found in the tissues of the intestines, or elsewhere. 7°. They did not find any bacteria of any kind in the blood, or in any other tissue. 8°. Many experiments gave the following results: (*a*) Mice, rats, cats, and monkeys were fed with rice-water stools, with vomitus, with mucus-flakes from the ileum, both fresh and after having been kept for twenty-four hours (the animals remained in good health); (*b*) Inoculations with recent and old cultures of the comma bacillus, and of the small straight bacillus, as well as with mucus-flakes, were made into the subcutaneous tissue, into the peritoneal cavity, into the jugular vein, and into the cavity of the small and large intestine of rabbits, cats, and monkeys; but the animals remained perfectly well and normal.

The commission hoped to conclude its labors and to return to England in December, when a detailed report of its work would be passed through the press at once. This report will be read with very great interest, for Dr. Klein's work has heretofore been excellent in its conscientiousness. It will be seen, however, that all their results are purely negative, so far as can be judged from the abstract before us; and judgment upon the work should be deferred until the evidence is all in. With Koch's positive results so recently reported, and the result of his further work still to come, the problem cannot yet be considered to be definitely settled.

Should some serious effort not be made to preserve the American bison from total extinction? To save some remnant of the vast herds of this noble animal which even a few years ago existed, some speedy and effective action is needed; and posterity will surely find a just cause of complaint against the present generation if such action is not taken. It is a mistake to suppose that extensive herds still exist in the Canadian north-west or elsewhere. Last summer a few animals made their way as far north as the Red Deer River, and scattered individuals are still occasionally found in the broken region about Wood Mountain; but it is doubtful if at the present moment there exist as many as a couple of hundred in all the plain country north of the international boundary. If any herds worthy the name are still to be found, it is in the Upper Missouri and Yellowstone region; and, judging from published statements concerning the trade in robes, these are on the verge of extinction. The preservation of an animal with the roving habits of the bison is undoubtedly a difficult problem, but should not prove an impossible one. Even if the Yellowstone Park were wholly unsuited for the permanent residence of the bison, some other naturally bounded tract might surely be found, in which a small herd of these animals might be allowed, as far as possible, to retain their natural habits and yet be protected from slaughter. A conscientious attempt in this direction would at least save us the disgrace of being found altogether supine in the matter.

While the Yellowstone Park may not afford the environment most natural to the American bison, may it not be in reality the best refuge it is now practicable to offer it? In order to preserve any number of these animals from slaughter, obviously it would be necessary to restrain their wanderings. In short, any remnant of the once numerous herds we may desire to preserve would have to be kept in an enclosed park; and this, in order to enable the animals to retain in any considerable degree their natural habits, should be of large size. It is therefore a matter that the government may very properly be asked to take in hand, it being beyond the ability or means of individual citizens. So widely scattered are the small remnants of herds which still exist, and so distant are they from convenient means of transportation, that even the procurement of a small band of from twenty-five to fifty — a less number would hardly suffice — would entail the expenditure of much time and money, and could even now be accomplished only with great difficulty, while, if delayed much longer, might become practically impossible.

A bison preserve, wherever located, would necessitate not only a large outlay at first, in securing the herd and providing a properly enclosed park, but also constant expenditure in the way of providing proper keepers. Unless some more favorable section of country, both as regards proximity to the herds and environment, can be selected for the purpose, a portion of the Yellowstone Park should at once be set aside as a bison preserve, be properly enclosed, and stocked with as large a number of bisons as it may be practicable to procure. In this way, while we should not have the bison in exactly a state of nature, we might be able to preserve indefinitely a respectable remnant in a semi-domestic state; somewhat as the Auerochs, the old-world congener of our bison, is preserved in a government park in Lithuania.

LETTERS TO THE EDITOR.

The muskrat carnivorous.

I HAVE seldom been more surprised than at the statement that the carnivorous habits of the muskrat have but just been discovered by scientific men. They are so often mentioned in treatises on American conchology, that a little reading would have prevented the error. Thus Dr. James Lewis says of the Unionidae, "They afford abundant food for the muskrat and mink;" and like quotations might be given. But the fact is not left out of sight in treatises on the Rodentia. In the 'Mammalia of New York,' published by the state, De Kay says of the muskrat, "It is also extremely fond of the fresh-water mussel (Unio), heaps of which, in a gnawed or comminuted state, may be found near their retreats." Tenney's 'Zoölogy,' a mere schoolbook, says, "Muskrats feed upon mussels, and roots of grasses, and aquatic plants." To my knowledge, they feed on Unios throughout the year, but mostly in winter and spring. The floor of my boat-house is covered with shells, left by muskrats, every spring; and I have often stopped at the heaps of shells by their holes to see what species occurred near. The fact that they eat fish has certainly been less known.

There seem to be four principal ways in which muskrats get at the animal in the mussel-shell. In a small lake near me there are very fine specimens of Anodonta fragilis, but in such situations that it is almost impossible to get the finest ones alive. The shells are large, but almost like paper; and the muskrat invariably tears off one valve. In the thicker shells of Seneca River, not far off, its common way is to break the thinner end of the shell. In the much heavier shells of the west and south, I have heard that they either gnaw the hinge-ligament, or allow the animal to freeze and open.

While speaking of the Unionidae, I may mention a curious circumstance. Very few of their shells are to be found on one shore of Onondaga Lake, which is flat and marly; and this is partly so because the animal burrows deeply in the tenacious mud, and is not easily dislodged. But I passed that shore one day when a number of Anodonta Benedictii were washed in. They were helpless in the waves; but, when they had rested a while on the beach, they got up on edge, protruded the muscular foot, got a firm hold on the marl, and worked their way back to the water with apparent ease. W. M. BEAUCHAMP.

A census of hallucinations.

In a letter which you published on Dec. 5, I mentioned a sort of census whereby we are inquiring what proportion of the population has experienced waking visions of absent friends; the object being to discover how far *chance* may account for the numerous cases where such hallucinations have coincided with the death (or some serious crisis in the life) of the person whose presence was suggested, or how far, on the other hand, these cases drive us to some such hypothesis as 'telepathy.' In a letter published by you on the same day, Professor Newcomb has objected that untrue answers may be given by persons wishing to amuse themselves at our expense. I am far from denying that persons may exist who would be glad to thwart us, and amuse themselves, even at the cost of untruth. But when the question is put, "Do you remember having ever distinctly seen the face or form of a person known to you, when that person was not really there?" it is not at once obvious whether the *amusing* untruth would be 'yes' or 'no.' In neither case would the joke seem to be of a very exhilarating quality; but, on the whole, I should say that 'yes' would be the favorite, as at any rate representing the rarer and less commonplace experience. 'Yes' is, moreover, the answer, which, as a matter of fact, it has been very generally thought we ourselves preferred; so that to give it might produce a piquant sense of fooling us to the top of our bent. But a moment's reflection will show, that, so far as the census might be thus affected, it would be affected in a direction *adverse* to the telepathic argument; for the commoner the purely casual hallucinations are reckoned to be, the stronger is the argument that the visions which correspond with real events do so *by chance*. And if the number of these coincident visions makes the chance-argument untenable, even when the basis of estimation is affected in the way supposed, *a fortiori* would this be the case if the *yeses* were reduced to their true number.

While on this point, I may add that in such a census as ours there are reasons why, quite apart from untruth, an unfair number of *yeses* are sure to be obtained. One chief reason is, that, when forms to be filled up are distributed on a large scale, it is impossible to bring it home to the minds of many of the persons whose answer would be 'no,' that there is *any use* in recording that answer. Their instinct is, that results, to be of scientific value, must be positive, like natural-history specimens. This difficulty has been encountered again and again; and I feel little doubt that the proportion of *yeses* to *noes* will in the end be quite double what it ought to be: in other words, the telepathic argument, if it prevails, will prevail, though based on data distinctly unfavorable to it.

As Professor Newcomb seemed to confine his objection to the results of the census, I need not occupy your space with a description of the various precautions by which we ascertain that our cases of *coincident* visions — of *veridical* hallucinations — are *bona fide* records. Suffice it to say, that, whatever the possible sources of error in our evidence may be, — and there are some which demand unceasing care and watchfulness, — deliberate hoaxing is a danger which we believe we can reduce to an amount that will not affect the validity of our general conclusions.

EDMUND GURNEY,
Hon. sec. of Soc. for psych. research.

14 Dean's Yard, Westminster, S. W.,
Dec. 22.

Dikes of peridotite cutting the carboniferous rocks of Kentucky.

Prof. A. R. Crandall, of the Kentucky geological survey, has recently discovered in Elliot county, of that state, several dikes of very interesting peridotite, which intersect the carboniferous formation. It very rarely happens that such youthful felspar-free, massive rocks occur in regions of so little disturbance as eastern Kentucky, and under such circumstances that their eruptive character can be established beyond question. Professor Crandall and myself, with the approval of the U. S. geological survey, hope to be able to give these rocks the careful study they ought to receive. J. S. DILLER.

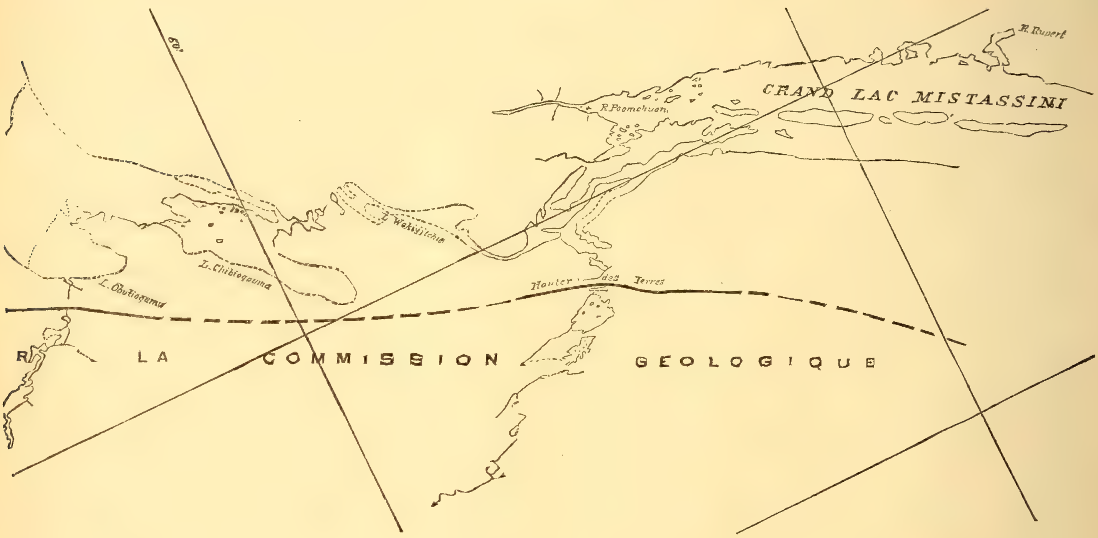
U. S. geol. survey, Washington, D.C.

Lake Mistassini.

Your contributor, Prof. J. D. Whitney (*Science*, No. 100), is quite mistaken in ascribing the recent newspaper paragraphs referring to Lake Mistassini

as having been caused by Professor Laflamme's communication to the geographical section of the British association at its late meeting in Montreal.

They commenced with a very sensational article in the *Montreal witness* dated Quebec, Nov. 17, arising out of an interview of a reporter with Mr. F. H. Bignell, a gentleman who had just returned from a trip to the Hudson Bay post on Lake Mistassini, made for the purpose of taking in supplies for the winter consumption of the party organized and despatched last spring, by the geological survey, to explore that region, and to complete the survey of the lake, which was commenced in 1870, and continued in 1871, as described in the report of the survey for those years, and of which surveys Professor Whitney does not appear to be cognizant, or of my letters to the editors of the *Ottawa free press* and the *Montreal gazette* of Nov. 17 and Nov. 25 respectively, in which the substance of the foregoing remarks was stated.



The only published map on which the result of these surveys of 1870 and 1871 by the geological corps is correctly laid down, and which Professor Whitney has probably not seen, is enitled "Carte de la Province de Quebec, Canada. Dressé au département des Terres de la Couronne, par Eugène Taché, assistant commissaire, 1880." The map is on a scale of fourteen miles to one inch; and on the face of it, in the Lake Mistassini region, we find the words 'Exploré par la commission géologique.' This map, and the report I have referred to, give the latest authentic published information about Lake Mistassini. The survey of the lake is, I hope, now in progress; and next year the size of it, and of its numerous arms, will be definitely known from actual measurement. Geologically it is a basin of flat-lying limestones, probably of lower Cambrian age, resting on Laurentian and Huronian rocks.

I enclose a tracing of the lake as it appears on the Quebec crown-lands map. The latest general map of Canada is that published in 1882 by the Department of railways and canals, Ottawa. I have not seen the Arrowsmith-Stanford map of 1880; but, in the recent maps I have referred to, the position of the lake is nearly half a degree west, not east, of that assigned to it in the geological survey map of 1866, while its outline is also very different. That it consists of several almost separate lakes, as described by the old explorers, is, I think, certain; but the assumption that there is a body of water in any way comparable to Lake Superior is exceedingly improbable, and not warranted by any recorded observations.

ALFRED R. C. SELWYN,
Director, geological survey of Canada.

Lava from the new volcano on Bogosloff Island.

Three specimens of the lava which was erupted from the new volcano on Bogosloff Island, Alaska, in October, 1883, were sent by Sergeant Applegate, the signal-service observer at Unalashka, to the central office in Washington, and referred to the U. S. geological survey for investigation.

It is gratifying to note that an examination of these specimens has verified to the fullest extent the hypotheses made concerning the source of the volcanic sand which fell at Unalashka, Oct. 20, 1883, and the mineralogical composition of the lava from which it originated. The facts noted in Mr. Applegate's letter of information render it altogether probable that the volcanic sand came from the new volcano on Bogosloff Island, and a comparison of the sand with lava from that place removes all doubt.

The members of the party from the Corwin sank almost to their knees in soft ashes; and other facts, already published in *Science* (Nov. 7, p. 432), indicate that a considerable portion of the new mountain may be composed of ejectamenta. It has been stated upon the authority of Lieut. Stoney, I believe, that "the mass of the volcano was found to be a species of sand-rock, with large black rocks scattered about the crust. No traces of lava, and but small quantities of pumice, were found." Whether the 'large black rocks' referred to are portions of lava-streams projecting through the coating of sand and lapilli, or large ejected fragments, is difficult to conjecture. We are led to believe that the specimens received were taken from such masses. Through the courtesy of Mr. Merrill, I have been able to compare

the specimens sent by Sergeant Applegate with those collected by Lieut. Stoney, and found them to be the same, hornblende andesite.

When we compare the lava from Bogosloff with the volcanic sand which fell at Unalashka, we find them identical in mineralogical composition. Both are composed of triclinic felspar, with prominent zonal structure, augite, hornblende, magnetite, and groundmass, with microlites and a small proportion of amorphous matter.

Dr. T. M. Chatard, of the geological survey, made a partial analysis of the volcanic sand from Unalashka as well as of the lava from Bogosloff. The former contains 52.48%, and the latter 51.65%, of silica. Fearing that an error had been made in the analysis of the lava, Dr. Chatard repeated the determination, and obtained the same result. That the percentage of silica contained by each should be nearly the same, can be readily understood; but that the lava should contain less than the volcanic sand which is composed of the same material, apparently with a larger proportion of basic minerals, was unexpected. Hornblende-andesite lavas rarely occur with such a low percentage of silica, and in this respect the one from Alaska is closely related to those in the Siebengebirge and Hungary. It is evident that the felspar contained must be very basic, probably anorthite. The optical properties of the felspar point in the same direction for the angle of extinction when symmetrical is over 30°. Hypersthene, which is such an important constituent of the lavas in the Cascade Range, has not been discovered in any of the lavas yet examined from Alaska.

J. S. DILLER.

U. S. geol. survey, Washington, D.C.

Action of pollen on seed-coats and pericarps.

I am confounded by a statement, given as if of a well-known fact, which I read in the 'Science bulletin' of No. 101. At a meeting of the Academyof natural sciences, Philadelphia, Dec. 16, —

"Mr. Thomas Meehan called attention to an ear of Indian corn received from Mr. Landreth, the grains on one side of which were of a rich brownish-red color, while those on the other side were of the usual pale yellow tint. On the boundary-lines several of the grains were partly red and partly yellow, thus proving that the result was not the effect of cross-fertilization, as had been asserted in other instances of change of color. It would indeed be strange if corn were the only plant in which such change of color was produced by cross-fertilization; *yet in the case of no other species had any such change been observed.*"

The sentence I have italicised is the confounding one. It is hard to believe that such a veteran horticultural editor and copious writer as Mr. Meehan is not acquainted at first hand with some of the horticultural literature upon this curious subject (extending from the year 1729 down to our own days), and which asserts that in various instances just such change has been observed. It is harder to believe that a writer who has shown such a critical familiarity with Mr. Darwin's writings should have entirely overlooked a section in chapter xi. of 'Variation under domestication,' vol. i., beginning on p. 397, in which the principal observations (convincing to Darwin's mind as to the facts) are brought together, and the sources referred to. One wonders how the fact that some of the grains of corn were party-colored in the case described, *proves* 'that the result was not the effect of cross-fertilization,' party-coloration in the flowers being a well-known effect of cross-fertilization, according to good authorities.

A. G.

THE PEABODY MUSEUM AT NEW HAVEN.

THE Peabody museum in New Haven stands on the corner of Elm and High streets, just without the *campus* of Yale college. Like most buildings devoted to science in America, it occupies only a part of the large lot, — a fact not designed to typify the unfinished state of zoölogy, but merely resulting from lack of funds. In the present case there would, perhaps, have been no building at all, and the collections, had any of consequence been accumulated at Yale, would have remained stuffed into garrets and cellars, had not the philanthropic George Peabody given a sum of money, in 1866, to erect a house for them. Thanks to the financial prosperity of Massachusetts, the bonds for a hundred and fifty thousand dollars had greatly increased, and those set aside for the first wing of the building had become worth a hundred and seventy-five thousand dollars when the trustees began to build. With that sum they have erected one of the finest buildings, for its purpose, in the United States, — a lofty and ornamental structure of red brick and cream-colored stone, whose broad and numerous windows express the desire of the investigators within for all the light they can get.

Let us begin our survey at the bottom. Entering the basement-door, a blind man, or at any rate a blind naturalist (if such there be), would know where he was by that smell of old alcohol with which biologists are so familiar. It is safe to wager, ten to one, that every visitor to these lower regions will remember and quote a certain line from 'The tempest,' act ii. scene 2.

This pungent odor rises chiefly from the possessions of the U. S. fish-commission, deposited for sorting and examination under the eye of Prof. A. E. Verrill, who is chief of the zoölogical part of the museum, or by some of his associates. Duplicates of these submarine and littoral specimens, secured in the government's deep-sea dredgings, go to Professor Verrill, and large quantities deposited by him in the museum have been arranged for exhibition.

In another part of the basement, Prof. O. C. Marsh keeps 'greate store' of fossils, cleaning the gigantic bones from Rocky-Mountain quarries preparatory to study and display. Considerable paleontological property of the U.S. geological survey is under inspection here also. A score of expert helpers, with Oscar Harger as chief of staff, assist; one of whom

has a little building to himself, where he is constantly employed in making restorations and casts of novelties, which are distributed with great liberality.

Only favored visitors go to the basement, or care to go. The public entrance is above, opening underneath a magnificent rose-window into a spacious court with tiled floor, and walls of variegated bricks. This region is garnished by great slabs of the celebrated footprint sandstones from the Connecticut valley, and a huge stump taken entire from a coal-bed. Iron staircases, clinging to the wall in spiral flight, lead to the top story, and the court is roofed with glass.

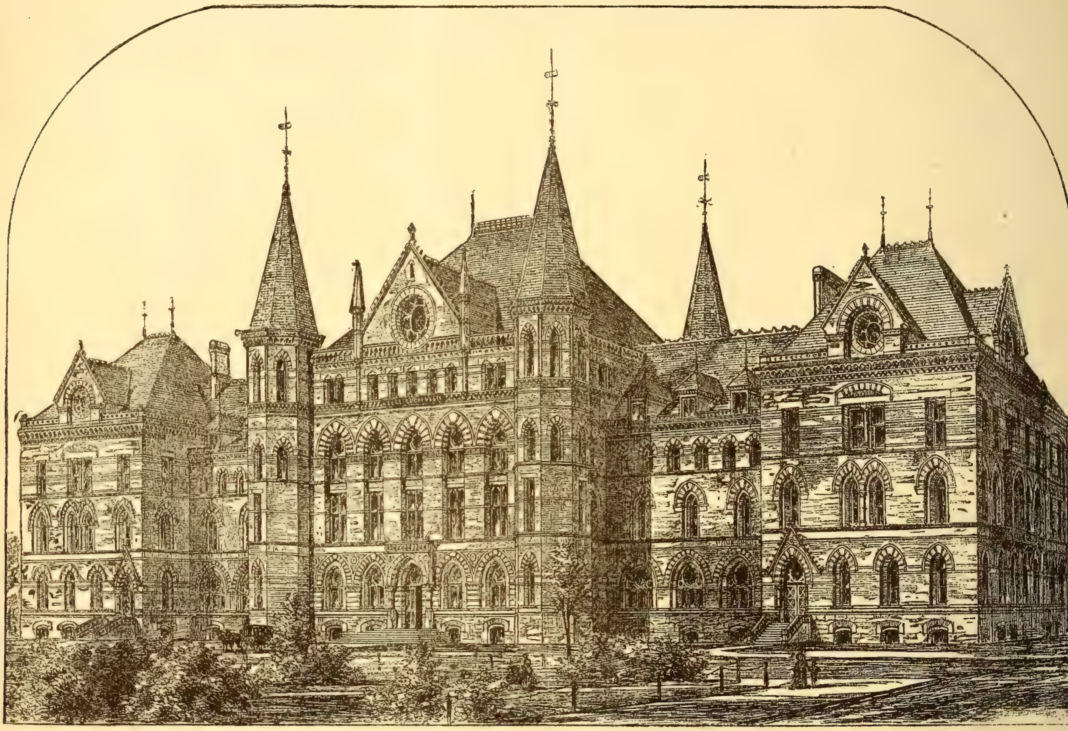


FIG. 1. — THE PEABODY MUSEUM AS IT WILL APPEAR WHEN COMPLETED.[1]

On the right and left of the entrance are doors leading to business offices, the blow-pipe laboratory, and the lecture-rooms of the Professors Dana (father and son), where large audiences frequently gather to hear the instruction designed for undergraduates alone; and in the rear of the court, on the ground-floor, is the exhibition hall for minerals, of which the museum possesses an almost unrivalled collection. This might be expected, considering the men — Dana, Silliman, Brush, and others — of whose labors it is the result.

To mention half of the notable minerals here, would exhaust the space set apart for the whole of this article. There were formerly several thousand dollars' worth of diamonds in one of the cases; but on account of their theft, though they were afterwards recovered, the labels now state that the present specimens are glass facsimiles. The only thing in this room not locked up is a meteorite weighing sixteen hundred pounds. The metal in one spot has been sawed off, and polished until it looks like burnished steel, and has been engraved with an historical inscription, from which it appears that this meteorite fell in Texas, presumably the only state in the Union large enough to receive it safely. In an adjoining case are a peck or so of small meteorites, picked up within a narrow area of Iowa, and of suitable size to be rained down upon a more thickly settled region.

After the brilliant and many tinted ores, the endless variety and beauty of the quartz crys-

[1] The right-hand third is already constructed.

tals, and the substantial interest inspired by the metals, visitors always pause with new gratification before some curious rosetted crystals of a form of lime; and a look of deep wisdom comes into their faces as they read the label. "Ah!" they exclaim, "I told you so. These are imported. I knew there could be nothing so pretty as that on this side. They do these things better in France, you know." And so they pass out, usually quite overlooking the 'educational series,' which has been spread with such pains for their instruction.

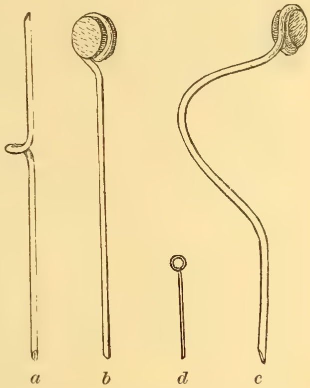


FIG. 2.—WIRES FOR MOUNTING MUSEUM SPECIMENS.

a, wire twisted so as to form a shoulder to prevent the specimen from slipping down; *b*, wire with the end bent around a disk of leather to which objects can be glued; *c*, a similar wire bent to fit inside a spiral shell, as in fig. 6; *d*, spiral label-holder used as in fig. 3.

This educational collection, which seems to be extremely apt and well selected, concentrates in a single case a practical glossary and text-book of mineralogy. To this epitome of the science all the rich and rare examples in the wall-cases are only attractive illustrations; and, the further to help the inquirer understand them, several copies of Dana's 'Mineralogy' will be found upon little tables near by. Here persons may sit and read, acquire and carry away the information, but not the *book*, for that is chained to an iron pillar.

The third floor is that most popular with the public, since it is devoted chiefly to modern animal life. The first thing to strike the eye in the south room is a fine series of comparative skeletons of primates, from civilized man down to the humblest of monkeys, all hanging in a beautiful row by hooks screwed into the tops of their heads. The set is usually spoken of as Professor Marsh's sunday-school class, but an unprejudiced mind can see that really there is no truth in this irreverent comparison. Beyond them, the whole side of the room is filled with cases containing an orderly succession of skeletons illustrating all the vertebrate orders; while the centre of the room is occupied by the skeletons and stuffed hides of the larger mammals, like the camel, rhinoceros, a very dejected polar bear, etc.

In the same room several cases are filled with stuffed skins of mammals, birds, and reptiles. Beside most of the land birds are placed their nests, with the eggs; or else the eggs are glued upon upright tablets of ground glass, in which position they show to excellent advantage. One large case is devoted to a collection of New-England birds alone, excellently mounted upon the branches of a tree. This is the work of Prof. W. D. Whitney, who, before he became prominent as a linguist, was known as a good ornithologist; as, in fact, he still is.

Passing to the west room on the same floor, one sees invertebrate preparations most attractively displayed. They are confined almost wholly, however, to the crustacea, mollusks, radiates, and marine protozoa. Of insects there is a very small showing,—only enough to represent scantily the classification of that immense class. This is partly because it is unwise to display insects freely, since exposure to the light causes their colors to fade, but is due chiefly to lack of material, owing to the fact that no entomologists of note have been especially interested in the progress of this museum.

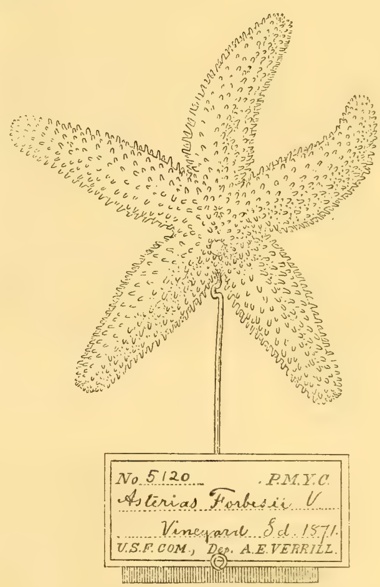


FIG. 3.—STAR-FISH MOUNTED ON WIRE FASTENED IN A BLOCK OF WOOD, WITH HOLDER AND LABEL OF THE USUAL PATTERN.

On the other hand, the special tastes of Professors Verrill, S. I. Smith, J. H. Emerton, and others, and the intimate relations the museum (through these gentlemen) has sustained with the Smithsonian institution and the U. S. fish-commission, have brought the department

of marine invertebrates to an almost unrivalled perfection. Case after case, all splendidly lighted, of rare and brilliant shells from every part of the world, vie with one another in attractiveness; while a magnificent series of crabs, sea-urchins, star-fishes, worms, corals, corallines, hydroids, and sponges, illustrates the classification, and exhibits the vast variety, of more lowly life alongshore and on the bottom of the deep sea.

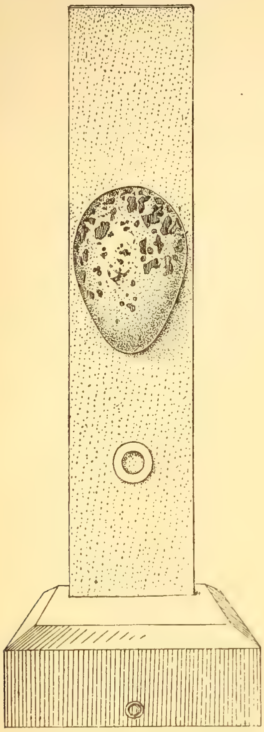


FIG. 4.—BIRD'S EGG GLUED TO A STRIP OF GROUND GLASS STANDING UPRIGHT IN A WOODEN BLOCK.

(To make the attachment stronger, a leather ring is first glued to the glass, as seen in the figure on the lower part of the strip; and to this the egg is fastened.)

In no room does the casual visitor linger longer than in this one; while its contents are unusually interesting to specialists, because of the large proportion of type-specimens included. In many instances these are unique; as, for example, some of those beautiful orange and scarlet gorgonias or 'sea-fans,' — flat, branchless, mossy growths of calcareous matter, which resemble great masses of pressed seaweed. One case is wholly filled with these corallines; and it is doubtful whether any museum in the world can make a better showing of them.

The corals, also, are very fine, embracing many rare and even unique forms, as might be expected, remembering Prof. J. D. Dana's labors in that direction; so that only the Museum of comparative zoölogy equals this part of the cabinet.

In the way of deep-sea forms of crustaceans, and echinoderms also, a great number of novel species are publicly displayed, which were procured in recent dredgings by the fish-commission. Among them stand large jars holding alcoholic remains of the giant cuttlefishes upon which Verrill has written so many learned pages; and overhead hang Emerton's paper models of Architeuthis and a huge Octopus, which half the visitors take to be real devilfishes stuffed, and gaze at with fearful curiosity.

The system of mounting dry objects of small size, adopted here, is perfect. It consists in using a small standard of wire set in a block of wood sufficiently firm to stand upright with security, upon the top of which (that is, on the tip of the wire) the specimen is fixed in any attitude desired by means of a bit of leather or cork glued to it at some inconspicuous point (see figs. 4–7).

In the case of shells, this produces a singularly handsome effect. They are poised upright, and can be viewed from all sides without handling, while the label attached to the footblock is neither hidden by the object, nor hides it. The wires, often requiring much ingenious twisting and looping to adapt them to the needs of the irregular specimens and positions, are of brass; but, after each piece has been bent into the proper shape, it is silver-plated. The crabs are mounted in an equally attractive and accurate manner, these brittle and otherwise difficult preparations being treated by a combination of the method described above, with the twisted-wire arrangement familiar to osteologists. Upright tablets of ground or colored glass, to which specimens are glued, are also made use of for many objects. Here, too, as in the vertebrate hall, there is a synoptical collection of the invertebrates of New England, instructively epitomizing the local fauna.

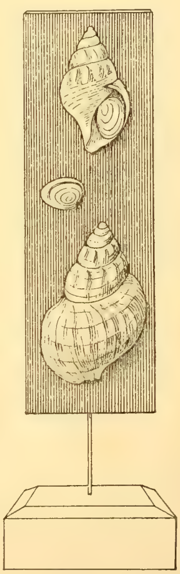


FIG. 5.—SPIRAL SHELLS GLUED TO A STRIP OF WOOD, PAINTED BLACK, FASTENED BY A PIN IN A WOODEN STAND.

The remaining rooms on this floor are occupied as laboratories or lecture-rooms by Professors Verrill and Smith of the Sheffield scientific school.

The fourth story contains storerooms filled with fossils; a collection (on exhibition) of about two thousand antiquities of great value from Central America; and a fair show of archeological relics, the most notable part of which is the pottery from the mounds of the Ohio valley.

But the glory of the Yale museum is its paleontological treasures, brought together wholly

by Prof. O. C. Marsh. The few representatives of this collection visible in the second-floor rooms and in the hall-ways are alone sufficient to stamp the museum as pre-eminent in this line; but they are merely an advertisement of what cellar and attic contain. It is not too much to say, that in respect to vertebrate paleontology (outside of fishes), this museum is not surpassed in the world. Where other collections own fragments or single skeletons, Professor Marsh boasts scores or hundreds of individuals, while many extinct races are known only by their fossil remains in his possession.

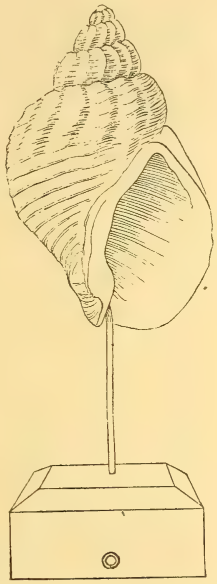


Fig. 6. — Spiral shell mounted on a wire like fig. 2, c, glued inside, and standing upright in a block of wood.

This is the result of wisely directed energy, and the ability to spend money promptly and liberally. Marsh's frequent expeditions to the far west are well known to geologists. Many car-loads resulting from these were not only shipped home by himself, but his agents have been forwarding enormous quantities ever since, from Wyoming and Colorado 'quarries.' Just before the holidays, a single instalment of two hundred and seventeen large boxes filled with bones from the western tertiaries arrived at the museum, and were stored in the basement lobby for lack of space in any apartment.

In respect to mammals, a series of fragmentary remains, chiefly jaw-bones from the eocene, represent the first primates, cheiropters, and marsupials discovered in North America. No more popularly interesting deduction is likely to be drawn from a study of them, than that which traced the genealogy of the horse from the diminutive five-toed progenitor of the early eocene to the present friend and servant of mankind. There are hundreds of specimens of these little horses at Yale.

In the class of birds, still rarer treasures may be catalogued. Along the eastern foot of the Rocky Mountains, certain strata of the middle cretaceous period have been exposed, corresponding to Meek and Hayden's 'Number three,' but termed 'Pteranodon beds' by Professor Marsh. These beds consist of fine yellow chalk, well adapted to preserving the remains of delicate structures; and here were gathered the skeletons of those remarkable 'birds with teeth' (Hesperornis and Ichthyornis), upon which Professor Marsh has published an elaborate memoir. These were collected during his expeditions of 1870, 1871, and 1872, under the greatest perils and hardships; and they have gradually been added to, until now the museum contains a hundred or more individuals, including twenty species of nine or ten genera. There are fifty specimens of Hesperornis alone. Several of the most perfect of these are on exhibition; and, as any intelligent person can comprehend their peculiarities, they never fail to interest thoughtful visitors.

Another fossil, appealing strongly to popular fancy, is the fine pterodactyl, — that same 'first specimen brought to light' which showed the bat-like flying membranes attached to the wings and tail. This came from Europe, where these winged lizards are so great a rarity in museums, that a fragment of one is highly prized; but Marsh now possesses from American rocks no less than six hundred individuals. Some are of great size, spreading wings that

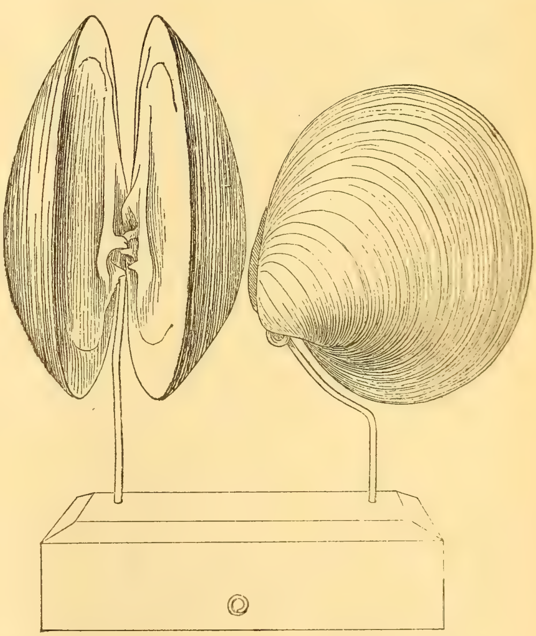


Fig. 7. — Bivalve shells mounted on wires glued behind the hinge.

measured from fifteen to twenty-five feet from tip to tip. These huge pterodactyls form the new order Pterodontia, and their remains were

gathered in the same middle cretaceous strata of 'western Kansas' referred to a moment ago.

Prized more highly than even these, however, are the hundreds of skeletons, or parts of skeletons, of gigantic walking and swimming reptiles, herbivorous and carnivorous, which inhabited the cretaceous ocean, and basked upon the shores of the islands of that age, now forming the heights of the Rockies.

Among the earliest were disclosed wonderfully preserved bones of the class of mosasauroid reptiles, — a group, which, though rare in Europe, here attained an enormous development, both in numbers and in variety of forms. Nearly seventeen hundred individuals, of this kind of giant-reptile alone, stand on the museum's catalogue.

The land-forms were even more terrible to the imagination, though their food was vegetable, and their disposition probably peaceful. One such sauropodan dinosaur shown to the public was sixty feet in length, and in general form came nearer to a crocodile than any thing else. A thigh-bone, lying in an exhibition case, measures six feet in length and is solid; so that it was well able to support the weight of the monster as it rose, kangaroo-fashion, on its hind-legs, to browse its food or to look about it.

In another colossal reptile (Apatosaurus) of nearly equal proportions, one of the neck-vertebrae is shown which is three and a half feet in diameter; while the ponderous bones of Brontosaurus prove, that, when living, the animal must have weighed twenty tons or more. The smallest part of it is the head; the skull and brain being more diminutive, in proportion, than in the case of any other animal now known. It had no weapons of offence or defence, nor even any armor; but in another genus (Stegosaurus) approaching it in bulk, though of more compact form, the body was protected by massive plates, and armed with long spines. This exaggeration of a cross between a snapping-turtle and a hedge-hog possessed a singularity in structure, since in one of the vertebrae of the haunch is a large nerve-cavity, which contained a second or posterior brain, supplementing the extraordinarily small nerve-centre in the skull. This feature has no parallel in the animal kingdom.

To Professor Marsh's personal collection somewhat has been added at the museum by the U. S. geological survey, which will become the publisher of the outcome of his studies now in progress. A score or so of assistants are constantly on duty, either in study, or in the mechanical work of skilfully extracting fossils from the rocky matrix; in matching and mounting by the aid of wire, clay, and plaster, for permanent preservation, the often badly broken bones of some antique brute whose extinction most of the world can accept with resignation; or in making casts, models, and drawings of fossils, original and 'restored.'

Several quarto volumes are already under way; and scarcely an issue of the *American journal of science* appears, without an advance note of some special discovery in vertebrate paleontology, anticipating the completer descriptions to be made from this museum's rich materials. ERNEST INGERSOLL.

RIVER-POLLUTION IN ENGLAND.

AFTER a delay which is much to be regretted, the English government has printed the reports left by Dr. Angus Smith on the working of the Alkali-works regulation act and the Rivers-pollution prevention act. As we mentioned at the time of Dr. Smith's death, he attached great importance to his examination of polluted waters. Great improvements have been effected in lessening the injurious vapors from chemical works. The new works registered are engaged chiefly in the manufacture of sulphate of ammonia and chemical manure. The smaller gas-works have found that they can more profitably manufacture and sell sulphate of ammonia than send their gas-liquor to a distance. The directions in which improvements have latterly been most marked have been in the treatment of sulphuretted hydrogen evolved in the manufacture of sulphate of ammonia, and in the washing of the gases evolved in the treatment of coprolites and other materials at the chemical works. In the former case, oxide-of-iron purifiers have been erected as the best means of preventing the escape of sulphuretted hydrogen; and in some works this gas is now completely burned, instead of being allowed to escape unburnt, up the chimney, as formerly. At others, Claus's method of burning so as to form sulphur, which is collected, and not sulphurous acid, has been adopted. Dr. Smith maintains, that, whatever process be used, the limit of sulphurous acid allowed to escape should not exceed five-tenths of a grain per cubic foot, including the acidity of the coal-smoke itself, which latter varies from a quarter to half a grain. The escapes from sulphuric-acid works have been considerably reduced, in consequence of the introduction of regular testing by manufacturers; and condensers to absorb the nitrous fumes have been put up in a number of nitric-acid works.

Dr. Smith's new method of testing with sugar the amount of organic activity amongst the microbes (at least, of a certain class) which exist in waters was mentioned nearly a year ago in the technical journals. He found that in nearly all natural waters sugar ferments, and hydrogen gas is then given off. So far as

natural waters are concerned, he found the giving-off of hydrogen to be an indication of the presence of microbes, and that the quantity in which the gas is given off appears to increase with the impurity of the water. Thus the waters on the uplands of Derbyshire give off less hydrogen when sugar is added than the same waters taken lower down in the valleys, where sewage enters the brooks. The addition of phosphate to the waters had a powerful stimulating influence; and as the examination of a soil for phosphate is a rather tedious process, and the condition of the phosphate a point difficult to examine, Dr. Smith suggests that his hydrogen process may prove useful in the discrimination of rich and poor soils; also it is a test of the influence of chemical conditions on soils and surfaces. And, obviously, if the giving-off of hydrogen is a test of microbe activity, the process applied to soils may afford a test of the miasmatic condition of particular localities. Indeed, Dr. Smith himself observes that the new light which the process promises to throw upon cases where there is microbe action suggests the examination of so many substances, that 'the end of the inquiry seems far away.' Having stated his results, and their probable immediate practical utility, Dr. Smith presents speculations bearing on ideas which are just now very prominent in the minds of microbiologists. He tells us that he hoped to examine the known microbes of zymotic diseases in order to see if they also produce hydrogen; and he evidently expected to establish a relation in this way between such microbes and the microbes of upland waters. "It is probable," he continues, "that in sewage we have, at some stage or another, the germs of every disease existing in the community, and perhaps, if intensified enough, the germs of every possible disease;" and later on he states the problem still more definitely. Is any germ of disease, he inquires, dangerous or otherwise, according to the conditions to which it is exposed? Is the activity of the microbes found in water diminished by aeration? Are microbes in water of value, and, as they assist in the production of hydrogen when sugar is present, do they assist in digestion, or are they obstacles to digestion? Do the microbes constitute some of the secret qualities of waters which have been found good or evil in the opinion of so many of mankind? In other words, is absolutely pure water wholesome? A curious speculation in which he indulges is, that, given the hydrogen test as a measure of the chemical activity of microbes, we have the basis for calculating the electrolytic power of the movements involved in the life of a single microbe, and thus for arriving at the mechanical equivalent of a disease-germ. In the second part of his water report, Dr. Smith has described additional experiments on the elimination of nitrogen during putrefaction in water, offering further evidence of what he calls the natural purification of waters (first by putrefaction, and then by oxidation) in continuation of the interesting exposition in the report for 1882.

In a third part, Dr. Smith gives the results of a long series of experiments by means of Dr. Koch's gelatine process on samples of water obtained from the most varied sources. The method consists in mixing a purified solution of gelatine with the water experimented upon. In very impure waters the gelatine is first rendered fluid at the surface; and this fluidity gradually increases until the whole becomes fluid. The fluid swarms with bacteria. The results are registered by photographing the test-tubes. It is significant that the results by the gelatine process correspond very fairly with the indications by the hydrogen process, approximate gradations of activity in the same waters being shown by both methods. The value of these investigations will easily be seen.

BARK-LOUSE SECRETION.

The past summer has been remarkable all through the northern states for the great numbers of large scale or bark lice. These lice have seriously injured our maples, white ashes, hickories, sassafrases, tulips, and elms. The eggs of these coccids hatch in May and June. The young lice attach their force-pumps beneath the leaves, where they sap the vigor of the trees the summer through. As the drying-up of the leaves in autumn gives a prophecy of a weakening stem, and prospective fall of the leaves, the lice desert the leaves, and attach their suction-pumps to the under side of the twigs and branches. I found that I could, by plucking the branches, hasten the migration of these lice from leaves to stem. The premature drying of the leaves caused the premature emigration of the lice. In early spring the scales — for now the lice are plump, scale-like creatures — grow very fast; and so rapid is the nectar secretion which exudes from the lice, that the leaves twinkle and fairly drip with this bark-louse nectar. The grass and walks beneath the trees become sticky with the unctious sweet.

The species of coccid which infests the maples secretes a cotton-like, fibrous mass, in which the eggs to the number of seven hundred or eight hundred are placed. This cotton-like nidus pushes out from behind, and raises the scale from the branch. In other species the hundreds of white eggs are concealed beneath the brown scales.

The nectar from these bark-lice is dark in color, of rank odor, and bitter and unpleasantly pungent to the taste. Though the bees appropriate this secretion, they refuse it entirely when they can gather from flowers. In actions they say, 'Better this than none, but never this when other is possible.' The bees regard this questionable sweet just as they do grape-sugar, — only to be accepted in lieu of naught else. The odor of this nectar is so rank, that its presence on trees is often quickly detected when one passes by. In many sections the past season the bees gathered this liquid by tons. I know of cases where the odor in the apiary was so strong that the bee-keepers thought they were victims to that terrible fungoid malady, 'foul brood,' which bee-disease is indicated by a nauseating stench.

This bark-louse nectar presents a strong contrast

to that of Aphides. It is dark, not light, in color; disagreeable, not pleasant, to the taste; distasteful to the bees, and not coveted by them; unwholesome for winter food for bees, and positively injurious to honey which is to be placed on the market.

Yet this bark-louse cloud has its silver lining. In early spring, before the flowers bloom, it stimulates the bees to their highest endeavor in breeding, so that well-stocked colonies greet the clover-bloom. The apiarist has only to extract this dark, ill-flavored honey at the dawn of the clover season, to convert a seeming ill into an unmixed blessing; especially as this coccid nectar is equally as good as honey for various manufacturing purposes, as the making of printers' rolls, the flavoring of cigars, and the manufacture of honey-cakes. Knowledge and caution on the part of the bee-keeper will keep this dark honey wholly separate from the other, and thus eliminate all harm, and make the former of no small advantage to him.

A. J. Cook.

ECONOMY OF FUEL.

How much can be accomplished in the way of economizing in fuel is shown by the results obtained lately on a trip of the Burgos, a freight-steamer built to carry cargo cheaply at a slow speed. Her engines are on the triple compound system, where the steam — in this case from a boiler-pressure of a hundred and sixty pounds per square inch — is expanded in three cylinders in succession. The average speed at sea, in all weathers, is very nearly ten miles per hour. In a voyage from Plymouth, Eng., to Alexandria, on the way to China, with a cargo weighing 5,600,000 pounds, and in a distance of 3,380 miles, the consumption of coal was 126 tons (or 282,240 pounds), being at the rate of 83.5 pounds per mile, or .03 of a pound per ton of cargo per mile: in other words, half an ounce of coal propelled one ton of cargo one mile. The *Railroad gazette* very neatly says, "Assuming that paper is as efficient a fuel as coal, we have only to burn a letter on board this steamer to generate and utilize enough energy to transport one ton of freight one mile. It is difficult to realize that so trifling an act as burning a letter involves such a waste of useful energy, or can have any reference to the energy sufficient to perform a feat which, under less favorable circumstances, requires a couple of horses and a teamster for about half an hour."

We may contrast with her performance that of the steamship Oregon, of the Guion line, where every thing is sacrificed to speed. The Oregon has engines of 13,000-horse power, 12 boilers, 72 furnaces, a cargo capacity some seven or eight times that of the Burgos, but intended for passenger business largely, attains an average speed of 17.9 knots (or 20.5 miles) per hour, and burns 337 tons of coal per hour, combustion taking place at the rate of over 16 tons of coal for each mile traversed. The cost of her coal for the voyage is put at considerably over $18,000.

The best locomotive performance in this country of which there is authentic record gives a consumption of about two ounces of coal per ton of freight hauled one mile, at the rate of thirteen miles per hour including stoppages, and rising to five or more ounces per ton per mile on grades of from fifty to seventy feet.

EXPLOSIVES AND ARMOR-PLATE.

During the last session of congress the theory was advanced that the effect of a moderate weight of dynamite, exploded in contact with the plates of a modern armor-clad ship, would be disastrous to the vessel. The Naval bureau of ordnance has tested this by exploding charges of gun-cotton and dynamite varying in weight from five to one hundred pounds, against a vertical target composed of nine layers of one-inch wrought-iron plates, strongly backed with twenty inches of wood, and braced so as to represent, as well as possible, the stiffness of the sides of a ship. Though much more work was done than it is likely would ever be performed against the armored side of a ship, the target was not materially injured.

In the course of these experiments it was apparently shown that the point at which a charge of a high explosive is ignited has an important effect upon the work done, since the effects of these charges were readily increased or diminished very materially, according as they were ignited on the side away from or adjacent to the plate; and this, too, notwithstanding the distance between the points of ignition in the two cases was only a foot. It is claimed that this result shows that the charge of a high explosive cannot furnish any tamping effect, but that to produce the greatest effect the ignition must be at some interior point of the explosive, well toward the rear. It also appears that the effects do not increase proportionally to the increase of the charge when the ignition surface remains constant.

The gradual ignition of the charge, even in the case of so violent an explosive as gun-cotton, was strikingly illustrated by the fact that when twenty-six pounds of wet compressed disks of that material were piled upon an iron plate, and exploded from the top (without tamping or cover), accurate impressions of the lower disks in the pile were stamped upon the iron underneath them. In this case there did not seem to be the least doubt concerning the complete explosion of the charge.

Experiments were also successfully made in firing shells charged with gun-cotton from ordinary rifled cannon, twelve rounds being fired from the twelve-pound howitzer, and thirteen rounds from the eighty-pound breech-loading rifle, and the ordinary service charges of gunpowder being used in the gun. Three unfuzed shells, charged with gun-cotton, were fired from the eighty-pounder against the target used in the dynamite experiments. The shells exploded with great violence, on impact; but the damage to the target was very slight, as the explosion took place before any practical penetration was effected. In view of recent successful experiments with a fuze

designed to explode wet gun-cotton, the bureau has under consideration a plan of a piece which is intended to project an aerial torpedo, charged with a hundred pounds of wet gun-cotton, to be exploded over or upon an enemy's deck.

RECENT RUSSIAN GEOGRAPHICAL EXPLORATIONS.

At the meeting of the physical section of the Imperial Russian geographical society, held Dec. 9, mention was made of Melnikow's archeological researches in the district of Troitzk and in the province of Mohilew. A few tumuli and prehistoric buildings had been examined, among which Melnikow claimed to have discovered cromlechs. Professor Sorokin travelled in central Thian Shan from Wernoje to the Issyk-Kul, thence by the Ula-Khom Pass to the Naryn valley, and by Mart Pass to Na-Manghan in Ferghana. Old buildings were found on the shore of the Issyk-Kul, but no traces of any under the water. Limestones of very new formation were discovered in the lake. Professor Muschketow gave a *résumé* of Konshin's travels in the steppe east of the Caspian, including a part of the old beds of the Amu-Daria, which was followed by an interesting discussion in regard to these beds.

At a later meeting of the society, Dec. 17, Mr. Lessar read a communication on the country and tribes on the Afghan frontier. He first recalled his remarks made last year, that the only means of thoroughly subduing the Turcoman steppe was to annex Merv, and that it was comparatively easy at that time on account of the prestige of Russia. His expectations had been more than realized, as not only Merv had been peacefully annexed, but the country of the Saryks, southern Turcomania, had submitted. The peaceful annexation of Merv was said to be partly due to the conviction of the people that they would never have peace while there was not a power strong enough to enforce it, and that Russia was this power. After the subjection of Merv, the Russians came in contact with the Saryks, who had been hitherto very little known. Lessar found a great difference between the natives of Jalatan, near Merv, and of Pende, which is farther south. The former are very poor, not even possessing the commodities most prized by nomads, viz., good field-tents, fast horses, etc.; while this kind of wealth is more abundant in Pende. The people are not entirely nomadic, but know something of agriculture. They make use of artificial irrigation, though their method of storing and conducting water is very crude, and they know nothing of levelling. Lessar made the interesting discovery that the mountains in the south are very low, and composed of soft strata; while the same chain is much higher and steeper to the west and east. The Salors, a small tribe living near Merv, are very poor, the probable reason being the long cessation from robbing expeditions, while agriculture and stock-raising are rendered insecure by the incursions of their neighbors. A. Woeikof.

EMMERICH ON THE CHOLERA BACILLUS.

The *Lancet* of Dec. 27, 1884, gives a very interesting *résumé* of a paper by Dr. Rudolf Emmerich, which is to be published in the forthcoming number of the *Archiv für hygiene.* The remarks are taken from advance proofs, and the original article has not yet reached us. The observations were made during the epidemic in Naples, and at the instance of the Bavarian government.

Dr. Emmerich did not limit himself to observations upon the comma bacillus, but attempted to discover other organisms by means of various culture-media and methods. He procured blood upon a sterilized platinum needle from the median vein of a young woman in collapse from cholera, and about six hours before death. He inoculated ten tubes containing nutrient gelatine in three places each, and found organisms in three of them, the other seven remaining sterile.

The organisms were all of one kind, cylindrical, with rounded ends, and occurring singly or in pairs, the length being about one and one-half times more than their width. They grow at ordinary temperatures in slightly alkaline nutrient gelatine, which they liquefy in solid opalescent patches. Under a low power ($\frac{100}{1}$), the colonies in the deeper portions of the gelatine present the form of a hone: those more superficial are like flat, circular mussel-shells.

The deeper colonies are yellowish brown by transmitted light, white by reflected light, and are finely granular. Those on the surface are pale yellow in the centre, whitish at the margin, and spread over the gelatine in a film.

These organisms were cultivated from the blood and from the internal organs of nine persons dead of cholera. They were most numerous in the kidneys and liver, then in the lungs, and least abundant in the spleen. They were found in sections of the intestines and kidneys (other organs not yet examined), and in very large numbers in the dejections and intestines after death. They grew in every culture experiment with alvine cholera material, whereas the comma baccilli only occurred in some cases.

Inoculation experiments were made at the Hygienic institute of Munich in conjunction with Dr. Sehlan. The animals used were mostly guinea-pigs, and symptoms were produced similar to those of cholera. The changes noticed varied from a simple desquamative catarrh, with rice-water-like intestinal contents, to hemorrhagic exudation, and destruction of the mucous coat.

The inoculations were made by the injection of two drops of a solution of a portion of a pure culture the size of a pin's head in two drams of water into the lungs, or subcutaneously. This produced an illness of from five to six days, with marked changes in the intestinal mucous membrane. The injection of a large quantity produced death in from sixteen to thirty hours, but with much less marked changes in the intestines.

The publication of the full paper is awaited with

very great interest. At present, and before we know the exact conditions under which the experiments were performed, it is impossible to form a correct judgment as to their value. The number of repetitions, and, in fact, all the details of the work, are needed in order to a just estimate of its correctness.

THE SCIENTIFIC PRINCIPLES OF AGRICULTURE.

Under the will of its founder, the Sherardian professor of botany in Oxford university was to hold also the Sibthorpian professorship of rural economy. The duties of both, but of the latter more particularly, were performed by Dr. Daubeny while he held this honorable post. His immediate successor, we suppose, gave his attention to the botanical chair; and the present incumbent, holding the ancient Sherardian professorship only, will doubtless give a fresh impulse to botanical study in the university. Under a chancery decree, the Sibthorpian professorship of rural economy is now independently established, and its duties defined "to lecture on the scientific principles of agriculture;" the amount of service is raised from 'one public lecture in each term' to twelve lectures annually; and Dr. Gilbert, for forty years the associate of Mr. Lawes at Rothamsted, and still so associated, was called to fill the chair. The continuous and well-concerted work done by these two men during the last forty or fifty years is now fairly well known and appreciated in all scientific circles; thanks, especially, to the extensive publication of a great part of the results in the Transactions of the Royal society. Mr. Lawes began his systematic investigations, we believe, while he was an undergraduate, more than half a century ago, by experimenting with manuring substances upon plants in pots; and when in 1834, on attaining his majority, he came into hereditary possession of the manor of Rothamsted, he at once set on foot the systematic experiments which are still in progress. It is understood that he has made ample provision for their continuance in the future. Although it could add nothing to his scientific fame, it was in fitting recognition of his services to his country that this inheritor of a handsome landed estate and a noble old manor-house was recently made a baronet. Equally fitting it is that Dr. Gilbert should now be called upon to present, in comparatively untechnical form, the general results and applications of his accumulated knowledge, and to inform the minds of those who will in great part become landlords, or country clergymen, or statesmen, to whom such instruction will form a proper and a very important part of a liberal education.

Dr. Gilbert's numerous scientific associates and personal friends in the United States, and not least those who had the pleasure of meeting him during his two visits to this country, while they read with interest the inaugural lecture delivered last spring, are hoping to have before them, in due time, the remainder of the course so happily begun, also its prospective continuation, to take the place in our day which was filled forty years ago by Johnston's lectures on agricultural chemistry and geology. 'A good deal has happened since then,' of which Dr. Gilbert can give excellent account. As an introduction to such an account, and to a popular exposition of the results attained during this interval, — much of it at Rothamsted, — nothing can well be more fit than this inaugural lecture. Agriculture is well said to be 'the concentrated production of food;' and the scientific principles upon which improvements in the art of concentrated production depend are drawn from the chemistry of the soil and atmosphere, and the chemistry along with the physiology of vegetation and of animal life. Of course, the subject will be treated by the present Sibthorpian professor from the chemical side. In this lecture the history of the subject is sketched from Saussure's analysis of plant-ashes in 1804, and Priestley's discovery of oxygen and of its liberation by growing plants, down to the researches of Liebig and Dumas, and ending with a sketch of the systematic field and laboratory work which has been carried on now for forty years by Sir John Lawes and himself. For the details of these prolonged experiments, and the full discussion of the results, see the elaborate memoirs published last year in the Transactions of the Royal society of London.

Introduction to the study of the scientific principles of agriculture: being the inaugural lecture delivered May 6, 1884, at the University museum, Oxford. By Joseph Henry Gilbert, Ph.D., LL.D., Sibthorpian professor of rural economy, etc. 47 p. 8°.

CHADBOURNE ON INSTINCT.

Prof. P. A. Chadbourne's Lowell lectures on instinct have reached a second edition; but the author has neither seen reason to alter the statements of the first edition, nor found time

Instinct: its office in the animal kingdom, and its relation to the higher powers in man. By P. A. Chadbourne. [Second edition.] New York, *Putnam's sons*, 1883. 323 p. 12°.

to incorporate in this one the new material that, as he tells us, he has prepared for a continuation of his discussion. This new material is to appear soon in another form; and, until it appears, we must postpone any detailed criticism in these columns of our author's known views. That the book contains much fair discussion of theories, and a very readable collection of facts, is plain enough; and, on the other hand, one need not dwell on the consideration, that, in their present form, these lectures cannot be considered as abreast with the advance of so rapidly growing a study as this. We shall add here only one criticism; namely, that there is, in this work, one obvious imperfection that has especially to do with our author's principal purpose itself. Professor Chadbourne studies instinct in animals that he may throw more light on the place and relations of instinct in man. But, just when he comes to speak of human nature, his psychological foundation is so antiquated, that all his learning helps us, his readers, but a little way. It is the old schematized and abstract psychology that is in his mind throughout, with its 'rational' and 'moral natures' of man, with its more or less complex scheme of subdivisions in each of these 'natures,' and with its notion of an abstractly defined hierarchy of human powers. For very elementary instruction, not in psychology as such, but in morals, this old psychology will still do well enough, no doubt, as a sort of rough working hypothesis; but the scheme is unreal, and modern psychology finds little use for it.

For this reason it is, that, when our author draws an elaborate parallel between the functions of the sense of obligation and those of the instincts, we feel that the undoubted actual likeness of these two sets of phenomena is distorted in his description, for the sake of fitting the facts to an *a priori* notion about the 'higher spiritual nature' of man. When he gives us an elaborate diagram, representing the place of the instincts among human faculties, we feel that this diagram represents a sort of stuffed soul, badly mounted, as it were, and no living soul of man at all. When, again, an argument for immortality peeps out from behind our author's classification of the belief in immortality as an instinctive human belief; when, in fact, we are told that one instinct ought to be as well founded as another, and that the belief in immortality is as much an instinct as is the instinct of an insect to lay eggs in autumn, — we feel only a sense of vexation that an ill-conducted analysis of human nature, accepted by our author from tradition, should be used by him for such a purpose in a scientific course of lectures. Why mix together utterly separate lines of consideration? Our belief in the real goodness of things, and in the worth of life, gains no whit, and can only lose force, by being confused with investigations into external physical phenomena, or even into the laws of the sequence of mental states. That tradition has long since sanctioned this confusion is no justification for it here.

RECENT TECHNICAL BOOKS.

CAIN'S algebra contains two entirely distinct essays. In the first of them, with the hope of making the treatment of negative quantities clear to the student of elementary mathematics, the author represents real quantities in the usual way, — by lengths laid off upon a straight line, towards the right from a fixed origin on the line if the quantities are positive, towards the left if they are negative, — and develops successively the rules for algebraic addition, subtraction, multiplication, and division, by the help of this concrete conception. The rules thus obtained are then shown to be generally applicable to all problems, whether the difference between positive and negative quantities in them is one of opposition in direction or not; and the essay closes with some remarks on the generality of formulas of trigonometry and analytic geometry proved for a single case.

In the second essay, Professor Cain describes some methods common to all sciences of reasoning, compares and illustrates by examples the analytical and synthetical methods for the solution of problems, and finally discusses a few examples in finding the equation of loci, where some solutions are lost in the course of the work, or where some strange ones are introduced. The distance of the point P' from the point P seems to be written indifferently PP' or $P'P$. The little book would doubtless prove interesting and suggestive to any student

Symbolic algebra, or the algebra of algebraic numbers, together with critical notes on the methods of reasoning employed in geometry. By Prof. W. CAIN, C.E. New York, *Van Nostrand*, 1884. (Van Nostrand's sc. ser., No. 73.) 131 p. 18°.

Testing-machines: their history, construction, and use. By ARTHUR V. ABBOTT. New York, *Van Nostrand*, 1884. (Van Nostrand's sc. ser., No. 74.) 190 p. 24°.

Stadia surveying: the theory of stadia measurements, accompanied by tables for the reduction of stadia field-observations. By ARTHUR WINSLOW. New York, *Van Nostrand*, 1884. (Van Nostrand's sc. ser., No. 77.) 148 p. 24°.

The steam-engine indicator, etc. By W. B. LE VAN. New York, *Van Nostrand*, 1884. (Van Nostrand's sc. ser., No. 78.) 169 p. 24°.

of mathematics who would spend a couple of hours in perusing it.

The historical part of Abbott's 'Testing-machines' is very brief, and consists of little more than a catalogue of machines built and used in the United States before the war. The second part of the volume treats of the construction of testing-machines, and the appliances used with them. The author describes very fully and clearly the apparatus made by the Fairbanks company, and much more briefly the machines of Emery, Riehle Brothers, Gill, and Olsen. The remainder of the book relates to the use of the testing-machine, and will be found a convenient handbook of instruction for beginners. It points out certain precautions which must be taken before and during a test; speaks of the appearance of the fracture as an indication of quality; shows what effect is produced upon results by varying the size of the specimen, the time of making the test, or the temperature of the piece under examination; and gives several valuable tables.

The author has apparently been very fortunate in obtaining definite indications of the 'elastic limit' by a method which he describes on pp. 84 and 138. As shown on his diagrams facing p. 82, this limit is indicated by a sharp change in the direction of the 'stress strain' line, amounting to nearly 90°, shortly followed by a sudden return of the line to its original direction.

These two points of inflection, occurring so uniformly in an otherwise regular curve, would seem to point quite strongly to some peculiarity of his apparatus. Indeed, we should expect something of the sort in the use of a testing-machine driven at a constant speed, as soon as the test-piece begins to stretch faster than the rate of the machine. The apparent elastic limit obtained in this way would not depend wholly upon the material tested, but could be made to vary by changing the speed of testing.

Most of Winslow's little treatise on stadia surveying is occupied by tables, — first, of horizontal distances and differences of level, to be used in the reduction of stadia field-observations; and, second, of logarithms (to four places of decimals) of sines and tangents, — but is preceded by forty-two pages devoted to an exposition of the theory of stadia measurements. This brief explanatory part would have been more satisfactory if it had been revised after its appearance in *Van Nostrand's engineering magazine*, so as to obviate the criticism which appeared in the number of the same magazine for June of last year.

In that paper it is shown, by Mr. R. S. Woodward of the naval observatory, that the formula expressing the relation between conjugate distances and the principal focal length of a lens, or system of lenses, is exact if properly interpreted, and applies equally well to any combination of lenses; and that the ordinary formula for the stadia instrument, if properly understood, is exact, whatever may be the number, kind, or disposition of the telescope lenses, so long as they are properly centred. This criticism, however, does not affect Mr. Winslow's statement of the general principles of stadia practice, but really confirms our belief in the superiority of stadia measurement to ordinary chaining. The eight pages of tables, previously used on the geological survey of Pennsylvania for reduction of observations, we think will be found serviceable to engineers engaged in stadia work.

Le Van's little book was prepared originally as a series of articles for the *Mechanical engineer* of New-York City. It has now been revised, extended, and re-written to some extent, for publication in its present form. It is an elementary treatise upon the indicator, and evidently intended solely for the class of readers to which it was addressed at its first appearance, — to those "whose education," as its author says, "has been and must be rather in the engine-room than in the class-room." Its publication in the periodical for which it was prepared is not a matter for public criticism; nor, perhaps, would be its presentation in this later form, except for the fact that the excellent work of Porter, its reproduction with doubtful propriety by an American editor and publisher, and the issue of the work of Mr. Pray (another 'expert' of unquestionable practical experience and skill), have hardly left a place for it. It lacks the precision of the first, and the thoroughly practical character of the other.

We find no satisfactory description of the familiar forms of instrument in the book. The introductory part contains a misleading calculation of the gain in fuel by expansion, showing an increase of economy which is never reached in the best of engines, and never even approximated in ordinary forms of the motor. The explanation of the indicator diagram, and the method of working it up, will be useful, and will be most carefully studied by the readers for whom the book is prepared. The fact that its author is thoroughly familiar, by practical use, with the instrument which he describes, is evident throughout; and this will probably aid in securing for it a sale.

ELECTRIC LIGHTING IN THE UNITED STATES.[1]

DR. ERNST HAGEN, professor of applied physics in the Royal polytechnic school of Dresden, visited the United States in 1884, and, having carefully examined the different systems of electric lighting there in vogue, presented a report to the directors of public buildings of Berlin. The largest portion of this report is devoted to the subject of incandescent lighting. A certain space is given to accumulators, and arc-lighting is also considered. The writer states in his preface that his travels have deepened in him the conviction that the subdivision of the electric light by means of the Hefner-Alterneck differential lamp gives a greater degree of steadiness than is possible with the lamp of any of the American systems.

The author enters at first into a comparison of the cost of electric lighting in general with that of gas and other sources of light. He shows that nearly ninety per cent of the energy produced by the ordinary gas-flame is in the form of heat, leaving only about ten per cent in the form of the radiations which appeal to us as light. He also discusses the subject of the noxious gases given off by illuminating-gas, and the poisonous compound called by DuBois-Reymond 'anthropotoxin,' which accompanies the carbonic-acid gas, and finds much to condemn in the use of illuminating-gas, and much good to expect in the further extension of the incandescent system of electric lighting. When amount of light and health are considered, the incandescent system is economical: viewed from the point of dollars and cents, however, this cannot be proved.

The author gives a short history of the development of the dynamo-machine, and the reader will find here a better summary than in any similar work with which we are acquainted. The use of diagrams and modest engravings, instead of the full-page illustrations of many recent treatises, is especially refreshing and comforting to one's pocket. The head is filled, while the pocket is not depleted, which cannot be said if one buys most treatises on electric lighting.

We learn from the chapter on the incandescent light, that Swan and Edison came almost simultaneously to the invention of the carbon-filament lamp, which, indeed, had been used in an imperfect way by inventors long before them. Both Swan and Edison reached the result of a more or less permanent incandescent lamp in 1879. The writer closes his history of the incandescent lamp by a glowing eulogy of the man who had the genius to create a new industry which employs hundreds of workmen, and to conceive of the grand project of lighting by electricity a great city from a central station. That this could have been accomplished without the careful training of the German polytechnic schools, evidently impresses the author.

Dr. Hagen corrects the impression, which is evidently carried abroad in certain quarters, that the whole of New York is lighted by the Edison system. He computes that New York proper covers eleven square miles, and the portion lighted by Edison embraces only a tenth of a square mile, and covers an area comprised within a circle of a little less than a thousand feet radius. A map of the region covered by this system in New York is given; and the dimensions and construction of the main leading wires, and the method of insulating them in underground pipes, are fully described, with a running criticism of the results that have been attained.

It is the author's opinion that large central electric-lighting stations will be established in all great cities, if the experiment in New York does not show some at present unforeseen obstacles. The system of underground wires forms, in his opinion, one of the greatest obstacles. There is no doubt that the insulation grows worse with time, and it is a question how much of the electrical energy is lost by defective insulation. He very properly remarks that the entire resistance of the circuit, including of course the lamps, must be considered, together with the loss of insulation in the underground conductors, and that even a very large loss of insulation might not consume more electrical energy than a single lamp.

The Edison plant is then carefully described, and the dimensions of the various machines fully given, together with the means of regulating the current, the method of weighing it and distributing it. We do not know where to look for a more careful description of the construction of the underground cables and the method of insulation. The author concludes, that, for equal amount of light, the Edison light costs about a third more than gas. In spite of this increased expense, the number of subscribers has continued to increase since the opening of the system, Sept. 3, 1883, and great satisfaction has been expressed with the light. Whether the system is suitable for

[1] *Die elektrische beleuchtung.* Mit besonderer berücksichtigung der in den Vereinigten Staaten Nord-Amerikas zu centralanlagen vorwiegend verwendeten systeme. Von Dr. ERNST HAGEN. Berlin, *Springer*, 1884. 8+307 p., illustr. 8°.

maintaining sixteen thousand lamps, even if only a fifth part would be in use at one time, and also for supplying power to small motors, is still in doubt. At present power is not supplied. It was intended that the system should be used for supplying power in the day-time, and light at night.

Leaving the central station in New York, Dr. Hagen then proceeds to inspect the village plant at Roselle, N.J., and studies this new and promising development of electric lighting, of which there are already several examples in the United States, notably that at Brockton, Mass. At Roselle three so-called two-hundred-and-fifty-light machines are installed, which are driven by a thirty-five-horse power engine. The price is a dollar per thousand candle hours (*kerzenstunde*). The electromotive force of the machine is 320 volts, and the current per lamp $\frac{48}{100}$ of an ampère. The number of lights in practical use is 800. The greatest distance to which the system is carried at present at Roselle is about 4,500 feet.

The writer then discusses the system of the U. S. electric-lighting company, which uses the Weston machine and the various modifications of the Maxim lamp, also the Bernstein electric-lighting system. The author closes his interesting and valuable discussion of the various systems of incandescent lighting by a *résumé* of the measurements made at Munich and at Paris, and an analysis of the cost of the Edison system. In this chapter will be found statements of the cost of this system from various agents of mills which are lighted by the incandescent light. So many elements peculiar to each installation enter into this analysis, that it is impossible to say in general what the cost of electric lighting is. Each business-man must decide for himself whether it is economical, on the whole, for him to use the electric light or not. In many cases there is decided advantage, and even economy, in its employment.

Dr. Hagen details in a graphic way the hopes raised by the various storage-batteries, and the leaden thoughts of those who have had their hopes dispelled. These batteries at present are useful only in laboratories.

The third portion of Dr. Hagen's treatise is devoted to arc-lighting, and in it the systems of Brush, of Weston, and of Thomson-Houston, are fully described. The treatise closes with a short essay on the dangers of electric lighting, and a copy of the regulations adopted by the board of fire-insurance inspectors in Boston.

NOTES AND NEWS.

MR. HENRY LOMB of Rochester, N.Y., has offered, through the American public health association, the sum of $2,800, to be awarded as first and second prizes for papers on the following subjects:—

1°. Healthy homes and foods for the working-classes: first prize, $500; second prize, $200. Essays to be of a practical character, devoid, as far as possible, of scientific terms. They must be within the scope and understanding of all classes, and designed especially for a popular work. 2°. The sanitary conditions and necessities of schoolhouses and school-life: first prize, $500; second prize, $200. 3°. Disinfection and individual prophylaxis against infectious diseases: first prize, $500; second prize, $200. 4°. The preventable causes of disease, injury, and death, in American manufactories and workshops, and the best means and appliances for preventing and avoiding them: first prize, $500; second prize, $200.

All essays written for the above prizes must be in the hands of the secretary, Dr. Irving A. Watson, Concord, N.H., on or before Oct. 15, 1885. It is expected that arrangements can be made to have these essays widely distributed to the public, and to the persons most interested in the respective subjects in the United States. The American public health association earnestly appeals to those able to compete, to take part in this work, which, it is believed, will do much to augment the health, comfort, and happiness of the people.

— In addition to the issue of its regular publications, the Leander McCormick observatory of the University of Virginia (Professor Ormond Stone, director) has begun the issue of a series of circulars, of which the number just received contains the elements and ephemeris of the small planet Barbara No. 234. The elements and perturbations by Jupiter were computed by Mr. S. M. Barton; and the perturbations by Saturn and the ephemeris, by Mr. F. P. Leavenworth.

— The quinquennial prize offered by the Belgian government for researches in mathematical and physical science has been awarded to Professor Le Paige of the University of Liége, for his investigations in the higher geometry, and especially for those relating to lines and surfaces of the third order.

— The valuable Cohen collection of Egyptian antiquities, which has recently been acquired by the Johns Hopkins university, will be of great interest, not only for art, but for the historical study of the customs and laws of Egypt. It was begun in 1832 by Col. M. I. Cohen, during his travels in Egypt, and consists of six hundred and eighty-nine objects, procured mainly in the localities where they were originally discovered. A number of objects, however, belonged to the famous collection of Mr. Salt, her Majesty's consul in Egypt, which was sold in 1835. The collection consists chiefly of small works illustrating the history of the minor arts in Egypt

from the xviii. dynasty to that of the Ptolemies. The university has also purchased casts, on a reduced scale of 1 : 10, of the two pediments of the temple of Zeus at Olympia. They had recently been executed at Berlin, under the direction of Curtius and Hirschfeld, by the sculptor Grüttner.

— E. and F. N. Spon announce as in preparation, 'Electricity in the house,' by E. Hospitalier, translated by C. J. Wharton ; also "The animal food-resources of different nations, with mention of some of the special dainties of various people derived from the animal kingdom," by P. L. Simmonds.

— Specific characters of considerable importance are found in the position of the resin-ducts and development of the hypoderm cells in the leaves of Abietineae, especially in the perplexing genus Abies. The value of these characters is recognized by special students of Coniferae; and material for the more general study of the structure of the leaves of all the North-American species, exclusive of those of Mexico, is now available for botanists. Mr. J. D. King of Cottage City, Mass., director of the department of microscopy in the Martha's Vineyard summer institute, has prepared and offers for sale microscopic sections of the sixty species of Abietineae of the United States. The sections are cut as thin as practicable, varying from a hundredth to an eight-hundredth of an inch, and are so prepared by bleaching and double staining as to show the cross-section and the whole structure of the leaf very perfectly. These specimens are prepared from material collected in connection with the census investigation of the forest wealth of the United States, and were supplied for the herbarium of the Arnold arboretum by Professor Sargent.

— The crisis in the grain trade, and the American and Indian competition in this commodity, are the topics of the day in Russia, and are being discussed in no less than three societies in St. Petersburg, each of them devoting more than one session to these topics.

— The need of a periodical of high character, devoted to the advance of archeological studies, and to the promotion of interest in them in America, is widely felt; and, to supply this need, it is proposed to publish quarterly, under the title of *The American journal of archaeology*, a journal devoted to the study of the whole field of archeology, — oriental, classical, early Christian, mediaeval, and American. The Archaeological institute of America has recognized the journal as its official organ. The following is a list of the editorial staff, so far as at present formed : advisory editor, Professor Charles Eliot Norton of Harvard college; managing editor, Dr. A. L. Frothingham of Johns Hopkins university, to whom all communications should be addressed; special editors, Dr. A. Emerson of Johns Hopkins university, Mr. T. W. Ludlow of New York, Professor Allan Marquand of Princeton college, Mr. A. R. Marsh of Harvard college, and Mr. Charles C. Perkins of Boston. A reserve fund is required in order to meet the deficit which must occur during the first few years of the journal's existence. Contributions to it are solicited, and may be forwarded to the Safe deposit company of Baltimore, which acts as trustee of the fund. Notification of such remittances should be made to the managing editor.

— Professor Spörer, at a recent meeting of the Berlin meteorological society, gave a brief sketch of the present period of sun-spots. The spot-periods being counted from minimum to minimum, the commencement of the present spot-period was to be referred to 1878. So far as had hitherto been observed, the present was distinguished from the last two spot-periods by two peculiarities, — first, that the maximum in the present period appeared to have occurred four-tenths of a year later than in the previous periods; and, second, that during the maximum, the distribution of the solar eruptions showed an essentially different character from that usually obtaining. In the former periods it was observed during the maximum that the greatest concourse of spots surrounded with faculae occurred in the median latitudes of the sun; that they were completely wanting towards the poles, became less numerous also towards the equator, and only at the equator itself did they again become somewhat more crowded. In the rotation of the sun, those eruptions showed a heliographic displacement towards the equator, in contrast to the spots free from faculae, which, in the course of rotation, wandered towards the poles. During the minima of the spot-periods the maximum of the eruptions was generally found in the neighborhood of the equator. In the present period, again, the greatest concourse of eruptions surrounded with faculae was found towards the equator during the maximum as well, — a phenomenon usually occurring at the time of the minimum. The present, on the other hand, resembled former periods in the circumstance that it was only on rare occasions that the concourse of spots was alike on both hemispheres of the sun. In the majority of cases, either the northern hemisphere presented a more copious display of spots than the southern, or the southern mustered them in larger numbers than the northern.

— The inhabitants of the small town of Gelnhausen, in Hesse, are putting up a bronze memorial bust of their distinguished townsman, Philipp Reis, as the inventor of the musical telephone.

— The Italian explorer, Capt. Cecchi, has sailed for the west coast of Africa in the Garibaldi.

— The lack of amusements at San Diego, Cal., is causing some talk of establishing a botanic and zoölogical garden. The great natural advantages, especially of climate, would make such an institution, in competent hands, of great practical utility and scientific value, and far less expensive to sustain than in the Atlantic states.

— Mr. Tresca reports to the French academy in the *Comptes rendus*, Oct. 6, that a system of electric lighting, including both arc and incandescent lamps, was arranged from the electrical exposition building in Turin over a distance reaching to 40 kilometres (24.2 miles). The committee of the exposition, in-

cluding Gaulard, Gibbs, and Tresca, established a circuit between the station of Lango and intermediate stations, — a circuit of which the total length was 80 kilometres (about 50 miles). The wire was of uncovered chrome bronze 3.7 millimetres in diameter. The current was produced by a Siemens alternating machine of the thirty-horse power type. New forms of secondary generators devised by Gaulard and Gibbs enabled the following different types of electric lighting to be maintained: 1°. At the exposition building, 9 Bernstein lamps, 1 Soleil lamp, 1 Siemens lamp, 9 Swan lamps, and 5 other Bernstein lamps placed at a short distance (these lamps required different potentials); 2°. At the station of Turin Lango, distant 10 kilometres, 34 Edison lamps of 16-candle power each, 48 of 8-candle power, and 1 Siemens arc-lamp. On the 29th of last September the system included the station of Lango, distant 40 kilometres, where 24 Swan lamps, requiring 100 volts, were maintained with perfect regularity.

— At Memphis, Tenn., on the Mississippi River, a caving bank rises straight up from the water's edge at its base to a height of from ten to fifty feet. To check the steady disintegration and undermining from the action of the current, the U. S. engineers are employing a method of protection which has been successfully tried at other points on this river. A blanket or willow and pole mattress is placed along the slope of the bank from high-water mark to the bed of the river. These mattresses are some fifty feet wide and from two hundred to a thousand feet long, of flexible willows bound together by poles and wire. They are made on boats having a length equal to the width of the mattress, and are built on an inclined platform, from which they slide down into the water as fast as woven. They are weighted and sunk by stones, and further secured by stakes. The sunken mattresses prevent undermining below the low-water line; and the grading-down of the overhanging bank, by jets of water thrown by powerful steam-pumps, stops all undermining above that line. The space between the upper edge of the mattresses and the top of the bank is protected with willows and stone.

— In some recent investigations on the growth of leaves, published in the *Journal of the society of arts*, Messrs. Zoller and Rissmüller have shown, that while in early summer the leaves of plants contain very considerable amounts of nitrogen, phosphoric acid, and potash, these substances are withdrawn into the wood of the tree with the advancing season; so that before the leaves fade they have lost the larger part of what was most valuable in them, which the tree retains for its future use. In some of these investigations on the leaves of the beech-tree, it was shown that in their water-free substance the highest 'percentage amount' of nitrogen, phosphoric acid, and potash, is found when they open or expand in the month of May, and this percentage quite regularly decreases till they ripen and fall; but the absolute amount of nitrogen, phosphoric acid, and potash, is greatest in July, and from that time on decreases.

— Mr. I. Millard Reade, C.E., F.G.S., in his presidential address to the Liverpool geological society on the denudation of the two Americas, showed that 150,000,000 tons of matter in solution are annually poured into the Gulf of Mexico by the Mississippi. This, it was estimated, would reduce the time for the denudation of a foot of land over the whole basin from a foot in six thousand years to a foot in forty-five hundred years. Similar calculations were applied to the La Plata, the Amazons, and the St. Lawrence, Mr. Reade arriving at the result that an average of a hundred tons per square mile per annum are removed from the whole American continent. This agrees with results he previously arrived at for Europe: the whole drainage into the Atlantic, if reduced to twenty kilometres at two tons to the cubic yard, would equal a cubic mile every six years.

— The nectar secretion from Aphides is a well-known product. In many cases, however, notably the larch plant-louse, the lice so mimic the twigs on which they rest, that their presence is hard to detect, especially as the lice are often confined to the upper branches of the trees. Often this nectar is secreted so abundantly, that the leaves, and the grass beneath the trees, are covered at early morning by drops so large that it is easy to collect a considerable quantity of the nectar. Sufficient of this nectar can be secured directly from the larch lice and the elm cock's-comb gall lice to test it. Bees are also known to gather it in large quantities. This Aphis nectar is very pleasant and wholesome, and unquestionably forms at times no inconsiderable portion of our most beautiful honey. Such honey is light-colored, pleasing to the taste, and perfectly safe as a winter food for bees. The truth of this statement is sustained by the fact that the bees work freely on such nectar, even though the flowers are yielding abundant nectar at the same time. The bees themselves practically proclaim the excellence of this Aphis nectar.

— The Royal observatory of Brussels has issued the second part of the report upon the transit of Venus of 1882. Two parties were sent out by the Belgian government, one of which located at San Antonio, Tex.; the other, at Santiago, Chili. This portion of the report contains a brief narrative of the experiences of each party, and the detailed observations which were made. The positions of Venus on the disk were determined solely by micrometric observations, which were successfully made at both stations, though clouds materially interfered with the work at San Antonio. Observations for time, latitude, longitude, and meteorological observations, are also given, and a chart is appended containing sketches of the optical phenomena noted at the times of contact. This report forms the second part of volume v. of the 'Annals of the observatory.'

— In No. 101, in the article by Mr. W. C. Winlock, entitled 'Comets and asteroids of 1884,' the date of the perihelion passage of Wolf's comet should be changed from Sept. 26 to Nov. 17. The name of asteroid (237) is 'Coelestina,' while 'Hypatia' is the name of (238).

SCIENCE.

FRIDAY, JANUARY 30, 1885.

COMMENT AND CRITICISM.

The lack of truly demonstrative evidence, in the solution of certain geological problems that have been regarded as settled for years before they are overthrown, finds new illustration in the remarkable results lately announced by the geological survey of Great Britain, which form the subject of a paper by one of the contributors to our paper this week. The conclusion, that now seems to be erroneous, rested on what may be called the argument from continuity of deposit. The same argument, involving the same error, was used by Werner nearly a century ago to prove the aqueous origin of his 'floetz-trap.' These old lava-flows apparently formed part of a continuous series with the underlying sedimentary strata, and hence were thought to be, like the latter, of sedimentary origin; and this conclusion held until an abrupt contact-line, that had previously escaped notice, was found between the dissimilar formations. Precisely the same reasoning has been employed in recent years to support the aqueous origin of the old lavas in the Palisades of the Hudson; but the method of disproving the error in such a case is now too well known, and in this example is too easily applied, to allow any general acceptance of so visible a mistake. In the same way, the essential element in the observations which Murchison and Geikie considered conclusive as establishing the Silurian age of certain Highland schists and gneisses was the continuity of the series, without break by unconformity or dislocation, from the underlying fossiliferous beds to the overlying crystalline members; and, on the strength of their report to this effect, the Silurian age of the now crystalline masses has been for years accepted by many geologists.

Now, it appears that these early observations were too hasty. Examination by more sceptical observers, and recent deliberate official studies mapped on the ideal scale of six inches to a mile, discover a most peculiar discontinuity in the form of a nearly horizontal surface of dislocation, across which the overlying mass has been driven actually for miles from its normal inferior position. Whatever possibilities may be discovered elsewhere, the paleozoic date for the metamorphism of the Sutherland crystalline series must now be regarded as incorrect, and the origin of their crystalline texture must be set back into earlier ages. The character of the dislocations thus revealed is as important as the disproof they afford of a serious error; and the inverted attitude that has been observed elsewhere between fossiliferous and crystalline beds will be examined over again in the light of these fruitful discoveries. These overriding Scotch gneisses may thus prove to be the connecting-link between the well-established alpine inversions that lay the fundamental gneiss on mesozoic limestone, as on the northern cliffs of the Jungfrau, and the still unsolved mystery in Norway, where crystalline schists seem to overlie the fossiliferous paleozoic sediments across wide areas, and thus give an abnormal character to the structure of the mountains, as shown in Törnebohm's section of the peninsula.

Then there is the extraordinary measure of ten miles for the horizontal displacement that is accountable for the whole difficulty in the Highlands; and along with this goes the occurrence of a number of (so-called) 'reversed faults,' in which the uplifted member has been thrust up an inclined plane. All of this is strong in evidence of the modern view that disordered mountain structures are characterized less by the gain of height than by the loss of breadth that they have suffered. The almost

incredible transgression of an older mass upon a newer one, now reported, has few parallels, unless one may be found in the famous overturning of the Windgällen Alps, studied out by Escher von der Linth, and confirmed by Heim. In the face of such an example, so utterly beyond explanation without the aid of irresistible lateral compression, we feel that the contractional hypothesis gains new support; and against the English school of physical geologists, who claim to show its insufficiency, the conclusion of Heim may be now quoted with new force: more may be learned of the earth's structure from critical observations on its surface than from calculations founded on physical assumptions concerning its interior. Besides these extraordinary facts of motion, the production of chemical changes during the mechanical stresses and distresses of the Highlands is hardly less remarkable. Sandstone passes into gneiss, and gneiss acquires schistosity, in a new direction in obedience to distorting forces. All this is beautifully confirmatory of Lehmann's conclusions from his researches in Germany during the past few years. Mechanical metamorphism thus gains the support of a series of facts that chemical metamorphism can ill afford to lose.

The article on this subject, contributed to the present number of *Science* by a well-known writer on these matters, contains certain statements to which exception may be taken. The questions raised with regard to the New-England rocks here referred to certainly cannot be considered 'settled' in the manner implied by our contributor, as was very evident at the Montreal meeting of the British association last summer; and the metamorphic origin of certain alpine rocks is not yet generally abandoned. As to 'regional metamorphism,' the revelations of recent detailed and minute studies in the field are not always such as to disprove it, but rather to attribute the metamorphic changes, where they occur, to mechanical instead of simply to chemical action; and, when disturbed and distorted rocks are found in altered mineralogical conditions over considerable areas, 'regional metamorphism' does not seem to be a misleading or confusing term to apply to them. Finally, the implication that Mr. Geikie makes insufficient reference to the results of his predecessors is certainly unwarranted. He states sufficiently that other observers have preceded him in the views he has now come to hold, and promises that they shall be duly mentioned in the detailed report which is to follow the present brief and preliminary publication. His outspoken frankness in admitting his previous error leaves nothing to be desired, and sets an example worthy of imitation.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Trowbridge's Physics.

In a recent number of *Science* will be found a criticism of Professor Trowbridge's 'New physics.' Those who have carefully read the work alluded to have doubtless found errors here and there, which would not appear in a second edition; but no one can fail to recognize a master mind in the organization of this new method of teaching natural science. The allegation that Professor Trowbridge has misstated some of the fundamental laws of mechanics is not sustained by a closer examination.

It is hardly necessary to point out that the formulae for the ballistic pendulum become perfectly intelligible if we understand by the first h, not the maximum height attained, but the observed distance through which the pendulum is acted upon by the force F, whose average value is thus determined 'without involving the element of time;' that the laws for the lever, which caused the critic even more surprise, are perfectly correct, when, as in the case in point, angular acceleration is considered, since the work spent upon equal masses, like their moment of inertia, is in this case proportional, as stated, to the square of the distance from the fulcrum; that it is indifferent, in the experiment, whether we find the length, or the radius of gyration, of the equivalent simple pendulum, since the two are identical; and that force is constant over the concentric spherical equipotential surfaces in question. The last two statements, therefore, as made by the author, need only to be restricted.

Such oversights as the critic is easily able to detect are not insidious, like some of those which have crept into many modern text-books. The underlying principles are brought out by the course of experiments in their clearest light; and therefore the work must be regarded by teachers as a safe and trustworthy guide.

It may be added that the experiments considered so difficult by the critic have already been employed with success in an elementary course, and are undoubtedly in place in any work whose object is to

elevate, rather than cater to, the present standard of physical instruction in the schools. W.

[The 'master mind' was distinctly recognized, and its presence cheerfully acknowledged, in the review to which the above refers. The reviewer heartily joins his critic in his desire for a 'closer examination' to determine the justice of the comments made. Such an examination will unquestionably show that every criticism made in the review is well founded. It will be generally admitted that an explanation which needs explaining is not extremely satisfactory. The points under discussion are such as are not usually considered in books with which the teacher is likely to be familiar; and erroneous and confusing statements will generally be accepted, although not understood. The result must be disheartening, if not disastrous. It seems wiser, therefore, to warn him to be on the lookout for errors which have not been eliminated from this first edition, but which are not likely to be found in a second. And this is especially true of a book which contains as many really good and original things as the 'New physics,' and which carries the weight which naturally and necessarily goes with any thing Professor Trowbridge writes. — Rev.]

The earthquake of Jan. 2.

Supposing that reasonably exact determinations of the time and character of seismic phenomena are useful, I send the following note on the shock of Jan. 2 at Washington.

I recognized the character of the shock at the instant of its occurrence, and timed it. On the following day, comparing my watch with one set to the standard (not local) time adopted for this city, I found the shock occurred at 9 h. 16 m. p.m., civil time, to which the correction to the Washington meridian is to be applied. My residence is close to Ascension church, on the highest land away from the boundaries of the city: the grade is ninety-two feet above mean level of the river, and two feet higher than the base of the capitol. I was in the third-story back room, facing east into the back-yard, and south into an alley. The house is of brick, and above the middle of the second story is isolated. The shock was a distinct and very heavy and sudden jar, not accompanied by noise, unless by a slight rattling of the windows, and lasted less than a second. The sensation was as if a very heavy body had struck the earth, yet also as if the jar were partly upward rather than downward. There was no second shock within fifteen minutes, although I saw a paragraph in the daily press to the effect that one individual alleges that he felt a second shock about 11 p.m. at Alexandria, Va. W. H. Dall.

Itinerant science-teachers.

In *Nature* for Dec. 25, 1884, there is described an 'itinerant method of science-teaching,' which "has been carried out on a large scale and with the most gratifying success by the school boards of Birmingham and Liverpool." A science demonstrator is appointed for a number of schools; and he is provided with apparatus, which is conveyed from school to school in a handcart 'by a strong youth.'

"The system," it is said, "fairly meets the objections which have been urged against the introduction of science-teaching, on the grounds of want of qualified teachers, want of time [to prepare for the lessons], and cost of apparatus. It also secures systematic and continuous teaching throughout the school-year. The teaching is practical, and every fact or law is demonstrated experimentally."

Would it not be well to try a similar plan here?

J. R. W.

[It would answer in large centres, but would be limited in its application to places where it might be said to be least needed. — Ed.]

The voice of serpents.

The text-books upon zoölogy represent that the vocal apparatus of serpents is very scantily developed, only enough to enable some of these creatures to hiss. A fact lately brought to my attention by Mr. George W. Leitch of Ryegate, Vt., is worthy of mention, and may lead herpetologists to search more carefully for the vocal apparatus of serpents. Mr. Leitch was stationed for several years at Manepy, Ceylon, as a missionary of the American board of commissioners for foreign missions. One day a serpent entered an apartment containing lumber, and it was deemed best to kill him. It became very angry, and made a loud noise, which Mr. Leitch says reminded him of the bellowing of a bull two years old. Perhaps others may know of instances in which these creatures make loud noises. This animal was of an uncommon variety, and was not preserved. It was of considerable size, say, seven or eight feet in length.

C. H. Hitchcock.

Hanover, N.H., Jan. 16.

The incandescent light on steamers.

In No. 102 of *Science*, in the article on 'Recent advances in electrical science,' Professor Trowbridge makes the statement that the Fall-River line took the initiative in adopting the incandescent system. This is certainly a mistake, as I myself saw it in full operation on the Virginia, of the Bay line (running between Baltimore and Norfolk), in the autumn of 1882, about a year before the Pilgrim was launched. Whether the Bay line was the first to adopt it or not, I do not know.

Everett Hayden.

U.S. geol. surv., Washington, D.C., Jan. 19.

Rainfall and crops.

Professor Snow's statement (*Science*, v. p. 13), that an annual rainfall of eighteen inches is entirely inadequate to maintain successful agriculture, is, I suppose, meant to apply only to Kansas, and, with that limitation, may be correct. In California, and especially in this portion of it, our experience is very different. Properly distributed, a rainfall of ten inches is ample to mature the cereals, and excellent crops are frequently raised with less. In the season of 1881–82 this place had 4.89 inches of rain, and there was an almost complete failure of crops, except on irrigated land. In 1882–83 there were 5.86 inches; and the distribution could hardly have been worse, almost all the rain falling after the 26th of March. Even under such circumstances there was some production on dry land, and the opinion was general that the crops would have been fair if the same amount of rain had come at the proper times. Last year the rainfall was almost unprecedented, reaching 18.32 inches. It was altogether too much. The crops were good, but they would have been far better if the last inch or two had been omitted. Of course, under different conditions of soil and climate,

eighteen inches may be too little; but here an assured minimum of ten, or even eight inches, would rob farming of all its terrors.

S. E. MOFFETT.

Kingsburg, Fresno county, Cal., Jan. 13.

The use of slips in scientific correspondence

To find that different workers have independently reached the same conclusions, or that they have adopted the same expedients to facilitate their work, is an evidence of the justness of the conclusions, or the excellence of the expedients. This reflection is suggested by the perusal of Professor Wilder's note of above title in *Science* of 16th inst , p. 44. At the time (May 15, 1867) when Professor Wilder announced to the Boston society of natural history his use of slip-notes, I remarked that I had used slips in a similar manner; and now I can say that my principal colleague in the editorship of *Psyche*, Dr. George Dimmock, has for a long time exchanged with me, and probably with others, correspondence-slips for purposes similar to those described by Professor Wilder, and that I have used the card-catalogue system with profit for all the purposes mentioned by Professor Wilder and for others.

The essential features of slip-systems for filing away notes are the use of a standard or uniform size of paper for all purposes, and the entry of but one subject on a slip. After many and various experiments in the attempt to combine these features with others which are desirable, I have found the following arrangement the most convenient for all files which are not kept as card-catalogues purely. I procure thin manila sheets, 23 by 15 centimetres, or about 9 by 6 inches, which are perforated with a cutting-punch near the left margin, at distances of 13.5 centimetres from the right margin, and 2.5, 7.5, 16, and 21 centimetres from the lower edge.[1] Any number of these can be bound together by shaking them into place, and passing a twine or thread through the perforations, which all correspond. Slips, of whatever size or shape, not exceeding 23 by 13.5 centimetres in size, can be lightly attached to the right-hand pages by mucilage on two or more corners of the slip. These can be extended, rewritten, or removed, without removing the sheets to which they are attached. The whole of the left-hand page serves for catch-words, classificatory headings and sub-headings, or whatever matter of similar character may be desired, referring to the reverse of the page. New leaves can be inserted, or old ones removed; in a short time, while at all times the notes have the advantage of being in book form, and free from the dangers of accidental displacement, as, for instance, by a gust of wind, or by dropping the package. For rapidity and ease of reference, I know of no better system. The removal of slips from envelopes, and replacing them, take a great deal of time; and the keeping of slips in card-catalogue form prevents a rapid survey of the material in hand. If it is desired to spread the whole material out on one surface, the strings can be withdrawn from the leaves.

The same manila sheets can be used for mounting newspaper scraps for permanent preservation; and pamphlets, circulars, etc., can be perforated with corresponding holes, so that all may be tied together in any sequence desired, and temporary covers, similarly perforated, may be placed on each brochure.

B. PICKMAN MANN.

Washington, D.C., Jan. 19, 1885.

[1] For an article by me on standard holes for temporary binding, see *Library journal*, January, 1883, vol. viii. pp. 6, 7.

THE DECADENCE OF SCIENCE ABOUT BOSTON.

A BOSTONIAN, proud of the scientific fame of his native place, and yet only too familiar with empty benches at the ordinary scientific assemblages, and to whom the election of new members, 'postponed for want of a quorum,' is a standard event, when he visits Baltimore and Washington, begins to ask whether the sceptre has not departed from Israel. He is thereafter a little shy about inviting a brother physicist from Baltimore to attend a meeting of the academy, or taking a naturalist from Washington into a session of the natural history society. To a friend about to visit the national capital, he unburdens himself with sad forebodings of the decadence of science at home; but 'tell it not in Gath,' he whispers as he parts. Nevertheless, it is an open secret.

The actual state of things is simply this, — that the meetings of scientific societies at Washington and at Baltimore are much more numerous and more specialized than at Boston and Cambridge, and present at nearly every session a more varied and interesting assortment of papers, which receive wider and freer discussion at the hands of much larger audiences. So far as interest and attendance go, the meeting in the southern city is what it formerly was in the northern; and it is a pleasant and yet sad reminiscence of earlier and better days for a scientific man from Massachusetts to visit his confreres at the south. He sees again the freshness and eagerness he was wont to see at home. The audience does not sit around the rear door, hat in hand.

It is not easy to see the exact reason for all this changed aspect of affairs in the north. Assuredly, never was more expected of science than at the present day. All men attend her words. Is it that each specialist has become so engrossed in the little corner of the universe he cultivates that he can scarcely see beyond that corner, and must needs keep to it even when he shows its products? Yet why should one's mental horizon be narrower at Boston

than at Washington, at Cambridge than at Baltimore? The only way we can account for this is in the undoubtedly freer social life at the south, by which men are brought into more frequent collision, with consequent interchange of ideas; and this would lead one to conjecture, that, unless manners change, Boston and Cambridge cannot regain pre-eminence.

It is all very well to say with a complacent air that science does not depend on the public, and that her great discoveries are made far from the noisy world. It is only in exceedingly rare instances that they have been made by men whose scientific ardor was not born of contact with living teachers. And men who seek wisdom for themselves alone defraud the public; especially in these latter days, when it is this very public that is to furnish their successors in the investigation of nature. The public covets no man's scientific gold or apparel, but has a not altogether unwholesome yearning for a sight of it; and it is a travesty of the scientific spirit to keep it from view. Science may be a mild hermit: she can never be a miser.

But to return to Boston. The decadence noticed within the last ten years cannot be attributed to any change of general manners in the modern 'Athenian,' but must be sought in other local causes, and may be largely apparent. The increasing proportion of scientific men residing outside of Boston itself has much to do, during the colder and stormier season, with the small attendance at meetings which it takes an hour's travel to reach; and yet it is rare to find at any scientific gathering in Boston, even if it be an attractive feast, any less proportion than one-half from Cambridge. The university, too, makes larger and larger demands upon its servants; and the extraneous attractions of Cambridge itself, not to mention those of Boston, absorb more and more the time and strength of those who were wont in former years to add to the interest of the scientific meetings in Boston. Their example is followed by their juniors, and Boston itself fails to make good its own loss.

THE GEOLOGY OF THE SCOTTISH HIGHLANDS.

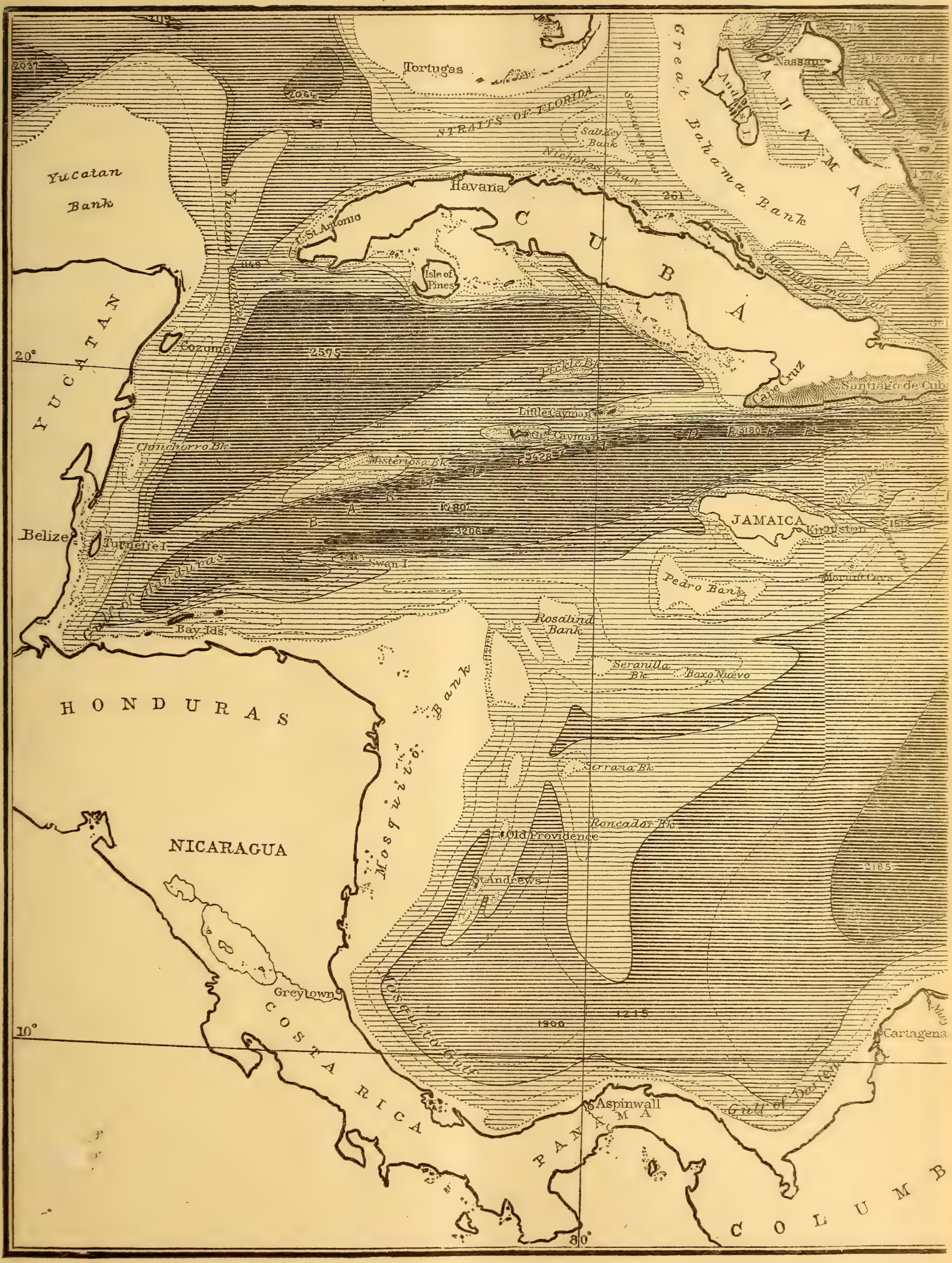
THE geology of the Highlands of Scotland has a peculiar interest for American students, first, because that region has many resemblances, both stratigraphical and lithological, to parts of eastern North America; and, second, because therein the same great questions which have been raised and settled with regard to New-England rocks, have there also been debated and finally solved, with similar results. There is in north-western Scotland an ancient gneissic series, which the present writer, in 1855, pointed out as the equivalent of our older gneiss, as seen in the Laurentides and the Adirondacks. Resting upon this Laurentian or Hebridean gneiss in Scotland, there is found to the east a group of quartzites and limestones containing a lower paleozoic fauna, in part, at least, Cambrian in age; while apparently overlying these fossiliferous rocks, on their eastern side, is a great series of gneisses and mica schists, rising into hills which form the western Highlands, extending south and east, and covering an area of at least fifteen thousand square miles. This whole region was studied a quarter of a century since by Murchison, aided by Ramsay and Harkness, and later by A. Geikie; and in 1858 and 1860 it was declared by Murchison that the gneisses and mica schists of the Highlands were newer than the fossiliferous strata, and were, in fact, rocks of Silurian age in an altered or metamorphic condition. As I pointed out in 1860, the parallelism between these Scottish rocks and those of New England and eastern Canada is evident. The ancient gneiss of the Adirondacks, the paleozoic strata of the Champlain basin, and the crystalline schists of the New-England Highlands, then regarded by most American geologists as of paleozoic age, are a counterpart of the strata of north-western Scotland, and I am aware that Murchison was sustained by these resemblances in his view of the age of the Scottish Highlands. It was, however, then opposed by Nicol, who maintained that these rocks, though distinct from those of the west coast, were, nevertheless, more ancient than the fossiliferous Cambrian found along their western base. I at that time shared the common belief of the metamorphic school of American geologists, and, extending it to the Scottish rocks, supported the thesis of Murchison and his colleagues against that of Nicol. When, however, I became satisfied of the errors of this school, and asserted the pre-Cambrian age of the various

groups of crystalline schists of the Atlantic belt in North America, I declared, in an address before the American association for the advancement of science, in 1871, my conviction that the crystalline schists of the Scottish Highlands "will be found . . . to belong to a period anterior to the deposition of the Cambrian sediments, and will correspond to the newer gneissic series of our Appalachian region." My studies of these, and of similar crystalline rocks in North America, in the British Islands, and in continental Europe, served in succeeding years to confirm this conclusion as to the gneiss of the Highlands, which was again asserted before the geological society of London in 1881.

Meanwhile the attention of able workers in Great Britain had been turned to this great problem in Scottish geology, beginning with Hicks in 1878, and followed by Callaway and Lapworth, all of whom labored independently of each other, but with concordant results. Their separate conclusions, as announced from time to time, but more fully in 1883, agreed in showing that the views of Murchison and his followers were altogether untenable, and in disaccord with the facts of stratigraphy. According to the results of these observers, published early in 1883, there are seen in the Highland region an older granitoid or Laurentian gneiss, and a younger series, consisting in large part of tender gray gneisses and granulites, with mica schists, which are the characteristic rocks of the Highlands, and have been variously named Upper Pebidian, Grampian, and Caledonian. They are indistinguishable from the younger gneisses of the Alps, and from the Montalban of North America, to which they were already referred in 1871. The unconformable superposition of the younger upon the older gneissic series, and the fact that the Cambrian strata rest unconformably upon both, and are younger than either, are also shown. The existence of great parallel north and south faults, with upthrows on their east sides, bringing up successively higher rocks; the fact that these faults pass into sigmoid flexures, in which both the younger gneiss and the Cambrian rocks were involved; and also that the younger gneiss is made to overlie the latter by dislocations, which were accompanied by a great thrust from the east, throwing both series into a succession of folds overturned to the west, giving the whole region a general eastern dip, — were made apparent, as may be seen in the various papers of Hicks, particularly that in the *Quarterly geological journal* for May, 1883, with appended notes by Bonney, and in the papers in the *Geological magazine* for the same year, by Callaway and by Lapworth, the latter entitled 'The secret of the Highlands,' besides a later one by Callaway in the same magazine for May, 1884, on Progressive metamorphism. An abstract of these results will be found in a chapter on the progress of geology, in the Smithsonian report for 1883.

The publication of these conclusions impelled the geological survey of Great Britain to direct its attention to the region for the purpose of defending, if possible, the previously expressed opinions of the official geologists; and, after investigations carried on in 1883 and 1884, the conclusions of the director, A. Geikie, and of his assistants, Messrs. Peach and Horne, are given in *Nature* for Nov. 13, 1884, and reprinted in the *American journal of science* for January, 1885. Therein, while making no special reference to the results obtained by his immediate predecessors, Geikie abandons entirely the views hitherto held by him in common with Murchison and Ramsay, and confirms those of Hicks, Callaway, and Lapworth. He writes that he has "found the evidence altogether overwhelming against the upward succession which Murchison believed to exist in Eriboll from the base of the Silurian [Cambrian] strata into an upper conformable series of schists and gneisses," and adds, "that there is no longer any evidence of a regular conformable passage from fossiliferous Silurian [Cambrian] quartzites, shales, and limestones, upwards into crystalline schists, which were supposed to be metamorphic Silurian sediments, must be frankly admitted." The same conclusions are also reached by Geikie from the re-examinations of similar sections in Rossshire, previously described by himself in accordance with the views of Murchison. The preliminary report of Messrs. Peach and Horne, with a general section, explains the structure in complete accordance with the statements already made by late observers, as explained above.

Geikie, in the paper just cited, calls attention to the laminated and schistose structure developed by the great pressure and friction along the lines of movement in the displaced gneissic and hornblendic rocks, and also to similar changes produced by the same agency in detrital rocks, such as arkose in this region. Both of these structural alterations are apparently included by Geikie under the head of what he calls a 'regional metamorphism.' This, however, is a misapplication of the term, likely to confuse and mislead the reader, since local



United-States Hydrographic Office, January, 1885.

THE BASIN OI

United-States Hydrographic Office, January, 1885.

THE BASIN OF THE CARIBBEAN.

F THE CARIBBEAN.

structural changes induced by mechanical movements in ancient crystalline rocks have nothing in common with that mysterious process which has been supposed by the metamorphic school to generate similar crystalline rocks from non-crystalline sediments. As regards the changes wrought by the same agency in detrital masses, it may be repeated that "the resemblances between primitive crystalline rocks and what we know to be detrital rocks, compressed, recemented, and often exhibiting interstitial minerals of secondary origin, are too slight and superficial to deceive the critical student, and disappear under microscopical investigation."

The doctrine of a regional and progressive metamorphism as the origin of the crystalline rocks, which was very widely received a generation since, both in Europe and America, has within the last fourteen years become greatly discredited. In the Alps, where it was first seriously applied, as well as in Great Britain, it is now generally abandoned. Callaway wrote not long since, that "every case of supposed metamorphic Cambrian and Silurian has been invalidated by recent researches;" and Bonney, now president of the Geological society of London, declared, in 1883, that the hitherto accredited "instances of metamorphism in Wales, and especially in Anglesea, in Cornwall, in Leicestershire, and in Worcestershire, have utterly broken down on careful study," as had already been the case in the Alps, and, it may be added, in North America. The official geologists in Great Britain, representing the traditions of the old school, have, however, hitherto held to the Scottish Highlands as their last stronghold, which they are now forced to abandon, — a substantial victory for rational geology.

T. Sterry Hunt.

Montreal, Jan. 10.

THE BASIN OF THE CARIBBEAN.

The U. S. hydrographic office having sent to the New-Orleans exposition, as part of its exhibit, a model of the Caribbean Sea, it will be interesting at this time to discuss the deep-sea soundings taken by officers of the navy in the coast-survey steamer Blake, and in the fish-commission steamer Albatross, from 1878 to 1884, by means of which this model was constructed.

Particular attention was called to this great basin in the coast-survey reports for 1880 and 1881, and also in a paper read by the writer before the American Geographical Society in the winter of 1882.

It was not possible, however, to give the contour of the bed of this sea until the completion of the work of the Albatross last winter. The data then obtained permitted the construction of the accompanying chart, which is a faithful representation of the model before mentioned, and by means of which it will be easy to draw attention to some of its most important features.

During the cruise of the Challenger, it was demonstrated that in a submarine lake the temperature is constant to the greatest depth, and the same as that of the ocean at the depth of the rim of the lake at its lowest or deepest point.

The investigations of the temperature of the Gulf of Mexico by Commander Sigsbee, from 1874 to 1878, had shown that below a depth of 800 fathoms the temperature is constant at $39\frac{1}{2}°$, which is the normal temperature of the ocean at that depth in the region of the Equatorial Current. It was evident, therefore, that the Caribbean Sea, from which the Gulf of Mexico receives its waters, must be enclosed by a rim which at its deepest part was 800 fathoms below the surface.

The purpose of the investigations of the Blake, during the time that I had the honor to command, was to verify the deduction thus made, and to determine the position and height of this rim, which limits the low temperature of the waters of the Gulf of Mexico.

All the passages between the islands from Trinidad to Cuba were carefully sounded, and the existence and position of the rim definitely established. At the same time temperatures were taken both outside and inside the basin, and at the points of minimum depth. With one exception, however, the only place where the rim was sufficiently low to admit water of the required temperature ($39\frac{1}{2}°$) was in the windward passage. In all other places the depths on the rim were much less than 800 fathoms.

The exception noted was a narrow gully of 1,100 fathoms, with a bottom temperature of 38°, leading into a basin of 2,400 fathoms between Santa Cruz and St. Thomas; this great depth also having a bottom temperature of 38°. As the temperature at 1,500 fathoms just south of Mona Passage was $39\frac{1}{2}°$, there could be no doubt of the existence of a rim from Santa Cruz to Puerto Rico. The Albatross, therefore, was directed to examine this locality, and, as was expected, found the ridge with 900 fathoms on it at the greatest depth, and a least

temperature of 39½°. This established the continuity of the rim, and consequently the truth of the deduction made from the examination of the temperatures of the waters of the Gulf of Mexico.

That part of the Caribbean Sea west of the Island of Jamaica, and the Pedro and Rosalind banks, were thoroughly sounded in the winter of 1880–81; and the Cayman Islands and the Misteriosa Bank were found to be part of a submarine extension of the range running along the south-east side of Cuba.

Immediately south of these partially submerged peaks was an immense deep valley, extending from between Cuba and Jamaica as

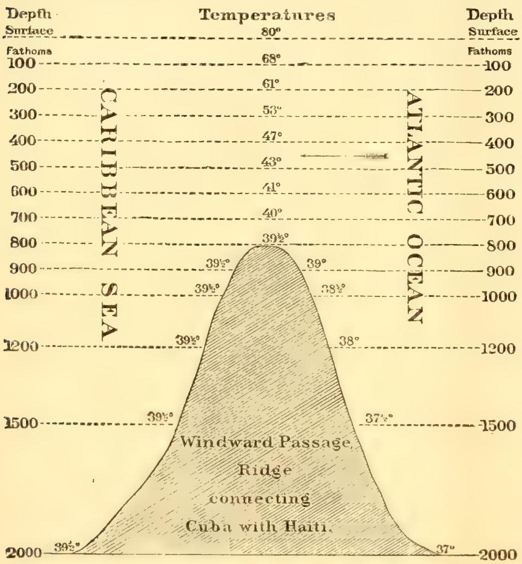


DIAGRAM OF RIDGE CONNECTING CUBA WITH HAYTI.

far as the Gulf of Honduras. This valley is narrow at its eastern end, but widens between the western end of Jamaica and Cape Cruz, where the soundings were 3,000 fathoms within fifteen miles of Cuba, and 2,800 fathoms within twenty-five miles of Jamaica. This valley is 700 miles long, with an average breadth of 80 miles. The greatest depth was 3,428 fathoms, just south of the Island of Grand Cayman. Between Misteriosa Bank and Chinchorro Bank, the soundings were regular at 2,500 fathoms. North of Misteriosa and Grand Cayman, to the Isle of Pines and Cape San Antonio, the soundings were generally 2,500 fathoms. So much for the western Caribbean.

The lines of deep-sea soundings taken by Lieut.-Commander Tanner in the Albatross last winter, were first from the east end of Puerto Rico to Bird Island, thence nearly south to Trinidad, and then north-west towards the Mona Passage. These lines, in connection with that which I ran with the Blake from the island of Dominica to Bird Island, and back to Monserrat, clearly developed a submarine elevation reaching north and south nearly parallel to the main chain of islands from Granada to St. Christopher; the depth on this ridge being considerably less than 1,000 fathoms, with 1,500 and 2,000 fathoms on each side.

From the Mona Passage a line was run to Los Roques, thence to the mainland, and then to Curaçoa. The soundings south of this chain of islands gave a greatest depth of 1,030 fathoms. A line was run from Curaçoa to Beata Island, at the extreme south point of Santo Domingo. A line was also run from Morant Cays, off the east end of Jamaica, to the mouth of the Magdalena River, and then across the Rosalind Banks.

These several lines show an immense basin of nearly the same depth, extending from Santo Domingo and Puerto Rico to the shores of the Spanish Main, and over an area of more than 200,000 square miles, without any apparent inequality of surface. A line drawn from the west end of Santo Domingo to Cartagena shows a depth of 2,200 fathoms. The floor of the basin then rises gradually to the banks connecting the island of Jamaica with the Mosquito Bank.

The basin is a few hundred fathoms deeper in its eastern part, but rises abruptly to the submarine elevation previously mentioned. A very remarkable depression will be observed in the Atlantic, north of Puerto Rico. Lieut.-Commander Brownson here obtained a depth of 4,561 fathoms. Additional soundings will be taken, when a vessel is available, for more details over the ridge of which Bird Island forms a part; but the general basin is probably correctly portrayed.

The soundings connecting the islands and various banks, and to determine the depths of the western Caribbean, have already been made in detail. This work, so eminently within the province of the navy, and performed with so much success by naval officers, should be continued, and I hope to obtain many new soundings this summer.

The model also shows the elevations of adjacent shores and islands. The horizontal scale is 33 miles to the inch; vertical, 6,000 feet or 1,000 fathoms to the inch. The latter, though so much distorted, was necessary to give the smaller elevations and depressions.

Even with this scale, the highest mountain

on the Isthmus of Panama was only one half-inch, and the elevation of the railroad less than one-twentieth of an inch. Again: the mountain of Santa Marta, near Cartagena, was 17,000 feet, or nearly three inches in height; but the whole gave relative heights which could have been shown in no other way.

J. R. BARTLETT.

U. S. hydrographic office, Jan. 15.

THE BALLOON IN METEOROLOGY.

ON the afternoon of Jan. 19 the first balloon ascent ever made in this country solely in the interest of meteorology took place at Philadelphia. As the beginning of a series to be carried out strictly for scientific purposes, it was an event of no small importance. Gen. Hazen, chief signal-officer, U.S.A., recognizing the importance and value of a more complete knowledge of the upper atmosphere, entered into a contract some time ago with the well-known aeronaut, Mr. S. A. King, for a number of 'trips to the clouds,' an ascent to be made at any time on eight hours' notice.

Although the first balloon excursion for strictly scientific purposes made in America, this was by no means the first on record. Naturally, very soon after the invention of the balloon, attempts were made to utilize it in meteorological investigations. Doubtless, the first ascents having this end in view were made by Mr. Robinson, from St. Petersburg, at the command of the emperor of Russia, in 1803 and 1804; but it does not appear that any important results came from them. On Aug. 31, 1804, Gay-Lussac and Biot made an ascent, reaching a height of thirteen thousand feet; and meteorological observations were commenced after an elevation of seven thousand feet had been passed. On Sept. 15 of the same year, Gay-Lussac reached a height of twenty-three thousand feet, making a series of most important observations, and bringing air down from that height, which, on being analyzed, was found to have the same constitution as that at the surface.

Not much seems to have been done from that time until 1843, when the British association for the advancement of science appointed a committee and voted a sum of money for the purpose of experimenting with captive balloons. Although the work was continued under several committees, it was not very successful, owing, doubtless, to a lack of skill in the management of captive balloons. In 1850 Messrs. Bixio and Barral made ascents in France for the purpose of meteorological study, in which it was planned to ascend to heights as great as forty thousand feet. They did not succeed, however, in reaching greater elevations than had been attained before, but obtained results verifying in the main those of Gay-Lussac. On one of these excursions an elevation of twenty-three thousand feet was reached; and, in addition to the meteorological work, interesting observations were made on polarization and other optical phenomena.

A series of very important ascents was made by Mr. Welsh of the Kew observatory in August, October, and November of 1852, in which heights varying from twelve thousand feet to twenty-three thousand feet were reached.

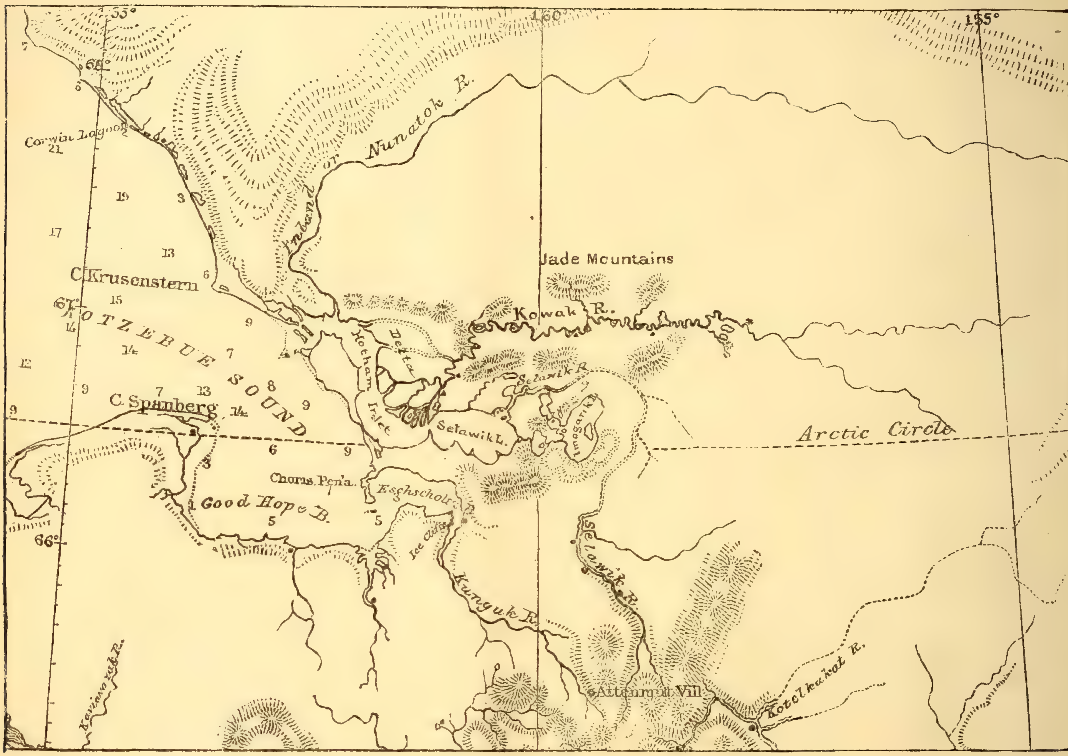
A few years later the interest of the British association in the subject was renewed, and culminated in the celebrated series of ascents made by Mr. Glaisher, the first being on July 17, 1862. In these ascents the most complete arrangements were made for the study of the physics of the higher atmosphere, and they were remarkably successful.

Since that time, scientific ballooning has been carried on with great success in France by Camille Flammarion, W. De Fonville, and Gaston Tissandier. A complete and extremely interesting history of their work (up to the date of its issue), together with that of Glaisher, is to be found in a volume entitled 'Travels in the air,' by James Glaisher.

The U. S. signal-service has had this subject under consideration for several years. Professor Abbe began in 1871 to collect meteorological records made in balloons. In 1872 the records of fifty ascents had been tabulated, studied, and valuable results obtained. In 1876 one thousand small balloons were sent with the Polaris expedition, to be used in determining the height of the clouds; but, owing to an unfortunate accident, they could not be utilized. At various times the chief signal-officer has sent observers on balloon excursions which were made for purposes other than scientific.

The considerable certainty with which the movement of a storm can now be predicted renders it possible and desirable to make systematic use of the balloon in the study of unusual atmospheric conditions, and the series of ascents just begun is planned with that end in view. Among other things, it is desired to determine the difference in the temperature gradient in well-defined 'high' and well-defined 'low' pressures. For this purpose it is necessary to foretell the arrival of a particular atmospheric condition at Philadelphia, from

which place the ascents will be made. This can readily be done so as to give the aeronaut eight hours' notice for the preparation of his balloon, and the observers who accompany him sufficient time to reach Philadelphia from Washington. The first ascent was expected to be rather experimental and suggestive in its character. It was the intention to start at seven A.M., on the 19th; and a telegram to that effect was sent to Mr. King, who responded that he would be ready. But, owing to the extreme hour of starting, the observations made were not so numerous as could be desired, although seven complete sets were obtained before darkness rendered further reading impossible. A safe and quiet landing was effected at about half-past seven P.M., near the village of Manahawken, on the New-Jersey coast. The greatest height reached was somewhat over one mile. This trial-trip has suggested some modifications in the plans, which will render future ascents more successful. The danger incident to a



THE NEW SURVEYS OF THE KOWAK RIVER, ALASKA.

cold, it was found that the balloon could not be handled for filling without danger of cracking; and waiting for the sun to warm it up caused so much delay, that the start was not made until quarter-past four P.M. The balloon was the Eagle Eyrie, holding twenty-five thousand cubic feet when filled, and having a lifting-power of about a thousand pounds. The occupants of the car were Mr. King and Private Hammond, a skilful observer detailed from the office of the chief signal-officer for the purpose. Mr. Hammond carried with him a complete outfit for making barometric, thermometric, and hygrometric observations. Owing to the late balloon ascent is greatly over-estimated by many. In the company of an experienced and skilful aeronaut the risk to life and limb is hardly greater than on a railway-train or a steamboat. Mr. Green, the famous English aeronaut, made fourteen hundred ascents, and lived to be eighty-six years old. The excursion of the 19th was the two hundred and fifty-eighth made by Mr. King. Volunteers for this service are by no means wanting among those connected with the signal-service; and Professor Abbé is so desirous of knowing what is going on 'inside of a storm,' that he means to make an ascent himself, in order to find out.

Altogether, this systematic use of the balloon for the study of special meteorological conditions must be regarded as a new departure; and the signal-service is to be congratulated on its successful initiation.

THE KOWAK RIVER.

THE map opposite shows the explorations made by the U. S. revenue marine on the Kowak or Kūak River during the season of 1884. The asterisk indicates the farthest explored point on the river. The native settlements are shown by small black triangles. The course of the lower part of the Selawik River and part of the Kowak delta, indicated in dotted lines, have not been explored. It will be observed that the new explorations almost exactly join the course of the river as laid down on the coast-survey map of 1884 by Dall, from Woolfe and Jacobsen's sketch-map. The spelling of the names on the above map has not been modified to agree with the Innuit pronunciation as obtained by Lieut. Cantwell, since the different tribes of the region do not pronounce these names uniformly, and the names 'Kowak' and 'Selawik' have been adopted on all charts for many years. According to Lieut. Cantwell, the people of the river call it Kū-ak (or 'big river'). Other names are Shēlāwik (Selawik, or 'fish') lake and river, Imogarik′-choit (lake or 'little sea'). The stream connecting this with Selawik River is Ig′-yăk ('throat') River: that flowing to Selawik Lake is Ki-ăk′-tŭk ('fox') River. Others have been referred to in our report of this exploration. It is probable that the upper part of the Selawik, taken from the Western union explorations of 1866–67, is too far to the westward, and that the course of the river is less irregular than above indicated; but there are not sufficient data to make this certain, or to alter the chart at present.

A GLANCE AT THE HISTORY OF OUR KNOWLEDGE OF FOSSIL PLANTS.[1]

THE ancients, though acquainted with fossil shells and corals, were wholly ignorant of fossil plants; and the first mention of any vegetable substance in a state of petrifaction was made by Albertus Magnus about the middle of the thirteenth century. Agricola, Gesner, and others treated of petrified wood in the sixteenth century; and, during the seventeenth, Major in Germany, and notably Lhwyd in England, called attention to the existence of vegetable impressions in the rocks. By the beginning of the eighteenth century considerable collections of such material existed in the European museums, and this had become the subject of animated discussion. Dendrite had long been known, and was then generally supposed to represent vegetable matter; but in the year 1700 Scheuchzer overthrew that doctrine, and established its purely mineral character.

Prior to this date the prevailing notions of the times ascribed all fossils to some mysterious cause, and denied their reality as the remains of things that had once possessed life. As to their true nature, there was, however, no harmony of opinion. Some looked upon them as divinely created archetypes of living things, others as divine enigmas placed before man to test his faith, others still as merely the varied forms of the subterranean world corresponding to those of the earth's surface, while many regarded such objects as purely accidental, or as mere freaks of nature.

Against these predominant mystic views there had, however, long existed the theory that these forms, so strikingly similar to real things, might be the petrified remains of the life that perished by the Noachian deluge, and which had been stranded on the mountains and highlands of Europe and Asia. This view was countenanced by Martin Luther, and strongly defended by Alexander ab Alexandro in the sixteenth century; while towards the close of the seventeenth it secured many earnest advocates, including Woodward of England, and Scheuchzer of Switzerland. The latter undertook to defend his theory from the evidence furnished by plant-remains; and from this zeal resulted his greatest work, one of the most remarkable of the time, — his 'Herbarium diluvianum.' This appeared in 1709, and in it are enumerated and figured many fossil plants. These impressions were declared to be those of existing and often familiar species; and we find among them the myrrh of Scripture, Galium, Hippuris, and other well-known forms. So confident was Scheuchzer that these were living plants, that in 1718 he ventured to classify all known impressions according to Tournefort's system, as drawn up in his 'Elémens de botanique' in 1694. The new edition of the 'Herbarium diluvianum,' which appeared in 1723, contained this systematic table, in which four hundred and forty-five species are enumerated.

This bold stroke aroused an intense interest in the subject, and immediately led to a closer comparison of the fossil with the living flora. In this work, Leibnitz in 1706, and Antoine de Jussieu in 1718, had already led the way by examining certain well-defined impressions, and expressing strong doubts of their identity with any European species. Further investigations were made; and these disagreements soon gave rise to the belief that they were tropical forms which by some convulsion or vicissitude had been brought to Europe, and buried under its soil. This view prevailed until the close of the eighteenth century.

Thus far the idea of ancient or extinct life had

[1] Read before the American association for the advancement of science, Sept. 8, 1884, by LESTER F. WARD.

scarcely been conceived; but continued failure to correlate fossil with living forms, even after thorough examination of many tropical floras, began to give importance to this question, and in the first year of the present century Baron von Schlotheim commenced to urge for plants, what Blumenbach had for some years insisted upon for animals, that the fossil forms were extinct, and belonged to another age of the world, characterized by a different kind of life. Hard as this doctrine then was for the beliefs of the times, its manifest soundness caused it steadily to gain ground, and soon opened the way for the serious study of paleontology on a true scientific basis.

The reaction against attempting to correlate fossil with living plants went too far, and the former nomenclature was completely abandoned. Judging all by the paleozoic forms, which had been the chief objects of study, all efforts to apply generic names even to those of the most recent formations were suspended, and resort was had to the terminologies of the mineralogists, particularly those of Waller, Walch, and Schröter. All vegetable remains were called phytolithes. Impressions on the rocks were distinguished as phytotypolithes. Fossil leaves were named bibliolithes, and fossil fruits carpolithes. Not until 1818 did any one venture to establish species under any of these heads. The first attempt of this nature was made in that year by the Rev. Henry Steinhauer, whose now celebrated memoir, 'On fossil reliquia of unknown vegetables in the coal strata,' describes and figures ten species of Phytolithus, assigning to each an appropriate specific name. This may be regarded as the true birth of systematic paleobotany, — an example of the humility of true science as contrasted with the arrogant assumptions of Scheuchzer a century before.

It is remarkable that this initial paper by Steinhauer was published in an American serial, the Proceedings of the American philosophical society, at Philadelphia, and was contributed by an American citizen, and member of that society. But that it was founded on any extensive study of the coal-plants of this country, as some have stated, there is no internal evidence. No American localities are mentioned; and the paper seems to deal throughout with British fossils and British coal-mines, with which the author was perfectly familiar.

Schlotheim, who in his 'Flora der vorwelt,' 1804, had not dared to go thus far, took a step in advance, two years later, in his 'Petrefactenkunde.' He greatly enriched the terminology of the science, and described with true binomial designations seventy-eight species belonging to seven genera of fossil plants.

Count Sternberg's 'Flora der vorwelt' commenced to appear in parts at about this time, in which many new genera were created on thoroughly studied grounds; and in 1822 Adolphe Brongniart's elaborate paper on the classification of fossil plants was published in the memoirs of the Paris museum of natural history. But these contributions, though highly systematic, and by far the most important that had been made to the science, did not descend to the question of species, nor indicate the number of distinct forms. The next work, therefore, in which light is thrown upon this problem, was Brongniart's 'Prodrome,' which appeared in 1828. By this time the science of paleontology had been fairly established, and geognostic considerations had come to receive something like their due weight. The ancient floras were distinguished from the later ones, and the approaching analogy of the latter to that of our own time was clearly perceived by Brongniart, who thus early prophetically declared for the successive development of higher types, though this view was strenuously opposed by the English school a decade later.

In this work, and the large treatise published the same year ('Histoire des végétaux fossiles'), to which it forms an introduction, an immense advance was effected in the systematic treatment of fossil plants. Not only was a large number of species recognized, belonging to the extinct genera heretofore established, and many new genera created, but the identity of many of the fossil with living genera was boldly asserted, at least for the more recent formations; and a long step was taken in the direction of correlating the extinct and living floras, and of demonstrating the fact of an uninterrupted series connecting the past with the present plant-life of the globe.

At that date Brongniart enumerates five hundred and one species of fossil plants, nearly half of which belonged to the first, or oldest, of his four periods, corresponding to the paleozoic of modern geologists, and of course chiefly from the coal-measures.

It is interesting to note here how much faster the science of fossil plants has advanced in this numerical respect than that of botany proper; for, while more than a hundred living species were then known to Brongniart for every fossil species, only eighteen living plants are now known to one fossil plant. And yet how rapid has been the growth of our knowledge in both sciences may be realized by contemplating the fact that nearly five times as many living, and sixteen times as many fossil, plants are recognized now as then.

A census of fossil plants was again taken in 1845, by Unger, in his 'Synopsis plantarum fossilium,' in which he enumerates 1,648 species; and in the same year, by Göppert, quite independently of the former work, in a paper published in Leonhard and Bronn's 'Neues jahrbuch für mineralogie,' in which 1,778 species are claimed. Sixty-eight thousand living species were then known to Göppert, or about thirty-eight living to one fossil species.

In 1849 Göppert again reviewed the fossil flora, and published an exhaustive enumeration in Bronn's 'Index palaeontologicus.' He now finds 2,055 fossil species, to be compared with the 69,403 living species named in the same work, or less than thirty-five living to one fossil species.

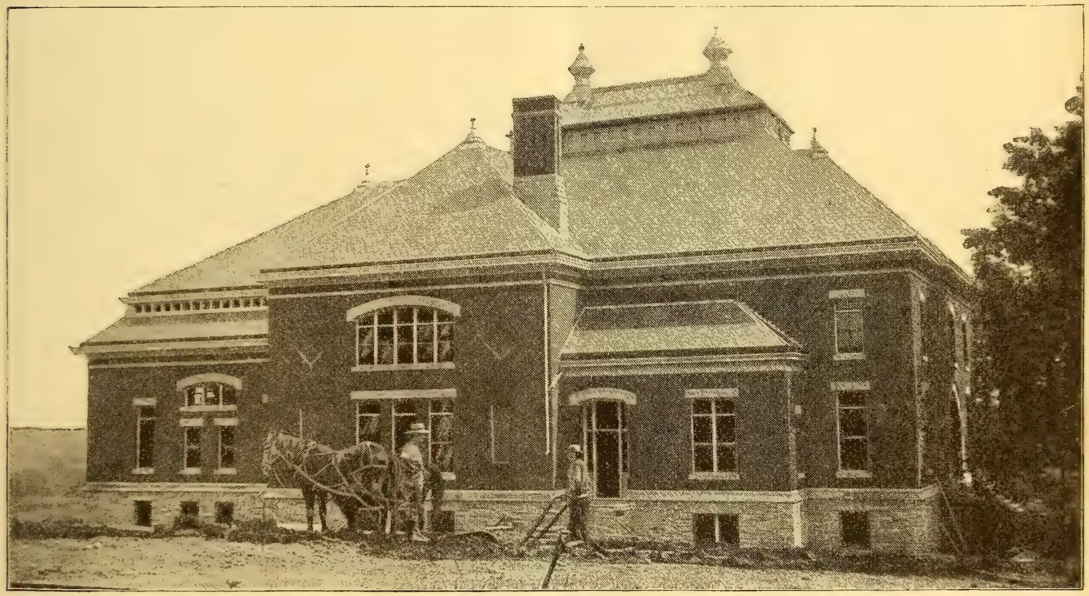
The third quarter of the present century was one of intense activity for systematic vegetable paleontology. The combined labors of Heer, Saporta, Ettingshausen, and Lesquereux, with a large corps of

co-laborers working upon abundant material from all parts of Europe, from the arctic regions, and from the United States, multiplied several times within a few years the number of fossil plants known to science; so that by the time of the completion of Schimper's 'Traité de paléontologie végétale,' in 1874, he found that he had been able to describe in that work about six thousand good species, after a liberal exclusion of uncertain forms. But a thorough inspection of this important work shows that even then he came far short of gathering in all the data extant at that date, while it is since then that most of the solid work in this line has been done in America and in the polar districts.

A catalogue of all the fossil plants that have been described, down to the present year, is in preparation at the National museum; and, though still far from complete, the work has sufficiently progressed to warrant an approximate estimate of the present number of species, which cannot fall far short of nine thousand, and may considerably exceed that figure.

PHYSICAL TRAINING AT AMHERST.

THE recent inauguration of the new health-building at Amherst college is a noteworthy feature in the development of this department of collegiate institutions in general. Amherst college was, it will be remembered, the first institution of the kind in America to awaken to the practical necessity of a competent physical culture proceeding simultaneously with the intellectual development of its students; and effective measures were taken to secure these ends nearly thirty years ago, soon after the accession of the late Dr. Stearns to the presidency of the college, when, in the year 1859, the board of trustees created the department of physical education and hygiene. Prescribed physical training four times weekly was constituted a part of the regular college course, and has been maintained under the immediate personal superintendence of a regularly educated physician, who exercises, in addition, a general oversight of the health of the college. And it is worthy of note here, that, while the experience of similar institutions elsewhere has often been very different, no epidemic has visited this college for the past twenty-five years, nor has any serious or permanent injury ever happened from the gymnastic exercises, either required or voluntary. From the outset the department which



THE NEW AMHERST GYMNASIUM.

had to do with the physical education of the student has been on equal footing with the other departments of collegiate instruction, and the facts of the relative attendance upon the required exercises in light gymnastics show that this position of the department is fully and cheerfully recognized by the students.

While in the conduct of the affairs of the new health-building, or Pratt gymnasium, — the gift of Mr. Charles M. Pratt of Brooklyn, — no radical change is contemplated, there is, with a greatly larger structure, more completely specialized apparatus, and all the conveniences for promoting bodily health as well as fostering physical development, a vast field for amplification of the work of the department which it is now in the strongest position to occupy. The interior arrangements of this structure present much that is new in college gymnasiums; and nothing has been spared to provide the most suitable forms of

every thing useful. In addition to the attendance upon the prescribed gymnastic exercises, it is found that a large proportion of the students, of their own accord, make use of the facilities here afforded for the acquirement of a complete physical development, and the maintenance of good health.

Not among the least of the far-reaching results of the work of this department is the uniform series of vital statistics obtained from all students of the institution, and which consist of a permanent record of certain bodily measurements and tests of the vital organs made three times during the course of the student at college. Since the inception of the department, nearly three thousand different men have been measured on a systematic plan, and the results have already formed the basis of invaluable contributions to anthropometry. The accompanying illustration is reproduced from a photographic view of the north front of the gymnasium.

SCIENCE AND SURGERY: A TRIUMPHANT RESULT OF EXPERIMENTAL RESEARCH.[1]

From the earliest ages, the functions of the brain have been a fascinating study to cultivated minds, and the greatest intellects of all ages have occupied themselves in attempting to solve its difficult and complicated problems. With the ancients this was a favorite pursuit, and engrossed the thoughts and talents of their most illustrious philosophers. Owing to the absence of exact methods of scientific observation and experiment, the conclusions on this subject were for many centuries of a purely speculative character, and the errors and fallacies thus deduced have been handed down and accepted till comparatively recent times.

Modern investigations have, however, thrown a flood of light on the question; and, although much still remains in the dark, the former obscurity has of late years been brightly illumined by the lamp of science. The accumulated clinical experience of ages had left knowledge on the cerebral functions in a state of confusion and uncertainty; and, owing to the obvious difficulties and complications associated with disease, the results, however significant, were at best imperfect. That the brain should be subjected to direct physiological experiment, was, until modern times, never attempted. During the last generation only, has the practicability of this been demonstrated; and numerous observers have, by direct operations on the brain-substance of animals, arrived at new conclusions as to its functions, and greatly revolutionized our ancient conceptions on the subject. Evidence has also been given against the *noli me tangere* theory, and abundant proof has been adduced of the fact that the brain may be handled, irritated, or partially destroyed, without necessary danger to life.

One of the latest developments of this method of investigation has been the discovery of those centres in the cortex which preside over voluntary motion, which have been, more especially by Professor Ferrier, differentiated and localized with great precision. This important knowledge has been arrived at by an extended series of experiments conducted on living animals, in which, by observing the several effects of stimulating or destroying limited areas of their brains, the different functions of these special localities have been determined. A topography of the cerebrum has thus been constructed, in which the various faculties have been mapped out; but these, unlike the illogical visions of the phrenologists, have stood the test of sceptical criticism and rigid experimental inquiry.

Researches of a purely scientific nature, carried out only with the object of elucidating truth and advancing knowledge, without immediate prospects of material gain, have in this instance led to most important and useful practical advantage. Armed with the knowledge acquired on animals in the laboratory, the physician has been enabled to utilize at the bedside the conclusions thus arrived at for the service of human beings. Clinical experience, combined with morbid anatomy, had already enabled the medical man to suspect the presence of disease in the brain; but as to its precise locality he was formerly in doubt. Now, however, guided by the recent revelations of physiology, he is enabled to predict the position in a large number of cases with great certainty and precision.

Evidence of this is afforded by the proceeding adopted in a case of disease, notice of which has lately appeared in the medical papers. It appears that a man presented a series of symptoms which enabled Dr. Hughes Bennett to diagnose a tumor of the brain, that it involved its cortical substance, that it was probably of limited size, and that it was situated at a certain definite spot. The skull was trephined over the suspected region: there a tumor was found and removed. On recovering from the immediate effects of the operation, the patient was, and continued for three weeks, in a satisfactory condition. He was perfectly intelligent; his functions, except for certain defects of motion caused by the disease, were normally performed; and there was an absence of all the distressing symptoms from which he had formerly suffered, and from which he must necessarily soon have succumbed. Unfortunately, at the end of this time a complication incident to all serious surgical operations supervened, from which the patient ultimately died. The unhappy termination of this particular case does not in any way detract from the importance of the principles which it involves. It still remains a signal triumph of diagnostic accuracy, — a precision mainly attained by exact experimental research. It is, moreover, further proof, that, by utilizing this improved knowledge, the surgeon may not only remove disease from the brain, but may do so without necessary shock or risk to the nervous system; and that the procedure, under modern antiseptic precautions, need not be attended with greater danger than may follow any other severe surgical injury.

[1] Reprinted from *Nature* of Jan. 8.

This interesting and instructive case will doubtless inaugurate a new era in medical practice; for, although this particular individual has succumbed to measures adopted to avert his otherwise certain death, the experience thereby gained is sufficient to encourage further efforts in a similar direction, which may prove beneficial to others. In the Marshall Hall oration of last year, Professor Ferrier remarked, "There are already signs that we are within measurable distance of the successful treatment, by surgery, of some of the most distressing and otherwise hopeless forms of intercranial disease, which will vie with the splendid achievements of abdominal surgery." He further added, reflecting on the success which had attended brain operations on animals, "I can but believe that similar results are capable of being achieved on man himself." That distinguished physiologist can but feel gratified that his prophetic words have been partially realized.

DISCOVERY OF SILURIAN INSECTS.

Some weeks since, we noticed the discovery by Lindström of a Silurian scorpion, Palaeophoneus nuncius, — the earliest-known air-breathing animal. To-day we reproduce in natural size a photograph of it received from Dr. Lindström. How quickly one discovery leads to another, is evinced by the curious fact that we now learn of the discovery by Dr. Hunter of another scorpion of the same genus in the Ludlow beds of Scotland, which are also referred to the upper Silurian. This second specimen, fortunately, is preserved so as to show the stigmata and 'comb' of the ventral surface, and will therefore offer more evidence as to its exact zoölogical position. It is in the hands of Mr. Peach of the geological survey, who described the carboniferous scorpions of Scotland with such care. Even this curious discovery is eclipsed by the announcement, at the last meeting of the French academy in 1884, of the finding of an insect's wing in the middle Silurian of Calvados, which Mr. Charles Brongniart, who announces the discovery, refers to a cockroach. It presents certain peculiarities, and among others an unusually long and straight anal vein. It is named Palaeoblattina Douvillei, after its discoverer. The oldest-known winged insects, up to this time, had been the Devonian insects of New Brunswick.

Palaeophoneus nuncius.

METEOROLOGICAL NOTES.

The Colorado meteorological association, recently formed, proposes to establish stations for observation at twenty or more points in Colorado, and has applied to the legislature for assistance.

In co-operation with the chief signal-officer, U.S. army, arrangements have been completed with the Old colony railroad, whereby 'cold-wave' flags — white, with a black square in the centre — will be displayed at eleven of the most important stations on the road, on receipt of telegraphic orders from Washington. The stations are Boston, Quincy, South Braintree, Brockton, Middleborough, Taunton, Somerset, Fall River, Newport, New Bedford, and Plymouth. An extension of this arrangement is in contemplation, so as to bring the daily weather forecasts issued by the signal-office into even more general notice than they gain by publication in the daily papers. Postmasters or town authorities in New England, desirous of undertaking the display of daily weather signals, are requested to address Mr. W. M. Davis, Cambridge, Mass.

Investigations upon the subject of ozone and the relation of its presence or absence to epidemic diseases are now carried on in various sections of the country. If sufficient encouragement is given, it is probable that observations will be undertaken by the New-England meteorological society, under the supervision of Dr. E. U. Jones of Taunton, Mass. Physicians and others who would be willing to engage in these observations are requested to address Dr. Jones. The cost will be about three dollars annually for each observer.

On the morning of Dec. 27, when the wind was everywhere light, the temperature at the summit of Mount Washington was +16°, while at stations at lower levels, north of the Massachusetts boundary, the temperatures ranged from —10° to —24°. A more striking instance of the disturbance of the usual law of decrease of temperature with increase of altitude is rarely noted.

In his 'Meteorological summary' for the year 1884, Prof. F. H. Snow states that the most notable features of the year 1884, in Kansas, were the low mean temperatures of the spring, summer, and win-

ter months; the high mean temperature of the autumn months; the very large rainfall, which came within half an inch of the extraordinary precipitation of the year 1876; the unusual percentage of cloudiness; the low velocity of the wind; the decided preponderance of south winds over north winds; and the increased percentage of atmospheric humidity.

The master of the steamship British King, from Swansea, reports, Jan. 15, in latitude 41° north, longitude 67° 10′ west, encountering an electric storm which lasted about four hours. The weather had been overcast with heavy rain from noon until six P.M., when the wind shifted from south-west to west, followed by loud claps of thunder and vivid flashes of lightning. At the same time large balls of 'St. Elmo's fire' were seen on all the yard-arms and mast-heads. All of the stays and back-stays were covered with sparks of fire of a bluish tint.

Professor Kiessling of Hamburg has issued a circular in the name of the Hamburg-Altona branch of the German meteorological society, asking practised observers, accustomed to noting the appearance of the sky, for reports on the colors still visible in the neighborhood of the sun in clear weather, as well as for records of the dates on which these peculiar displays first became visible. He regards them as sequels to the extraordinary twilights of 1883, and considers all these optical effects as results of the Krakatoa eruption. The phenomena on which observations are especially desired are the vaguely defined, smoky, reddish ring enclosing a brilliant whitish disk around the sun; and the pale red tint that has been seen between clouds at a greater distance from the sun, while the solar disk itself was hidden. Observations from distant, out-of-the-way stations are particularly valuable; and the records of mountain observatories are of greater interest than those of lower levels, as the solar diffraction ring is much more distinct when seen in the relatively clean upper air than when viewed through the dust-laden strata of the lower atmosphere. Professor Kiessling has published valuable papers on the optical theory of the brown-red ring in the *Naturforscher* and in *Das wetter.*

In his report on the New-Hampshire state triangulation in 1884, Prof. E. T. Quimby says, "It may be proper to mention that while the 'red sunsets' have not been so marked as they were a year ago, the Krakatoa dust has been constantly and plainly visible from sunrise to sunset every day when the sky has been free from clouds. There has been no day when the sky has had its normal blue."

THE CHEMISTRY AND PHYSICS OF THE SEA.

Forchhammer showed in 1864, by his analysis of several hundred samples of sea-water, that, though the water of the ocean may vary greatly in degree of dilution, the composition of the saline matter in solution is, for surface-waters, and so far as concerns the chlorides and sulphates of sodium, magnesium, and calcium, — the principal components, — constant within the limits of error of his work. Besides these more important constituents, other substances to the number of twenty-four elements are known to occur, but in their entire sum amount to but a small fraction of one per cent of the total saline matter.

In part i. of the volume before us, Professor William Dittmar gives his researches into the composition of ocean-waters collected by the Challenger. Seventy-seven samples, representing different stations upon the ocean, and various depths beneath the surface, yielded figures, which, agreeing fairly well with those of Forchhammer, and better still among themselves, seem to warrant the conclusion that the composition of the salts in sea-water is independent of the latitude and longitude of the station from which the water is taken, and of depth also, so far as concerns the chlorine, sulphuric acid, magnesia, potash, soda, and bromine. The proportion of lime, however, increases with the depth of the water. The following table contains Professor Dittmar's figures for the mean composition of the salts in sea-water, in comparison with those of Forchhammer: —

	Per hundred parts of total salts.	Per hundred of halogen calculated as chlorine.	
	Dittmar.	Dittmar.	Forchhammer.
Chlorine	55.2920	99.8480	Not determined.
Bromine	0.1884	0.3402	Not determined.
Sulphuric acid (SO_3)	6.4100	11.5760	11.88
Carbonic acid (CO_2)	0.1520	0.2742	Not determined.
Lime (CaO)	1.6760	3 0260	2.93
Magnesia (MgO)	6.2090	11.2120	11.03
Potash (K_2O)	1.3320	2.4050	1.93
Soda (Na_2O)	41.2340	74.4620	Not determined.
(Basic oxygen, equivalent to halogens)	(−12.4930)	–	–
Total salts	100.0000	180.5840	181.10

Or, combining acids and bases arbitrarily,

Chloride of sodium	77.758
Chloride of magnesium	10.878
Sulphate of magnesium	4.737
Sulphate of lime	3.600
Sulphate of potash	2.465
Bromide of magnesium	0.217
Carbonate of lime	0.345
Total salts	100.000

The difference between surface and intermediate waters in the contents of lime was 0.0125

Report of the scientific results of the voyage of H. M. S. Challenger during the years 1873-76. Physics and chemistry. Vol. i. London, *Government,* 1884. 307 p., 278 pl., map. 4°.

parts, and that between surface and bottom waters 0.0132 parts, referred to a hundred parts of halogen. The fact that deeper waters do contain more lime than surface-waters, Professor Dittmar attributes to the action of life near the surface in removing lime from solution, and to the tendency of bottom-waters to take it up from the ocean-floor.

As is natural, the alkalinity, too, increases with depth; and the difference between surface and bottom waters in this respect corresponded in Professor Dittmar's determination to 0.014 of lime, which is so near to the figures found in the direct determination of the lime, that the closeness of agreement must be accidental.

Concerning carbonic acid in sea-water, the evidence goes to show, that, as a rule, it is present in insufficient amount to convert to bicarbonate that base which is in excess of the sulphuric acid and halogen, and is free only exceptionally; that in surface-waters it varies inversely with the temperature, and for equal ranges of temperature seems more abundant in the waters of the Atlantic than in those of the Pacific Ocean. The quantities of oxygen and nitrogen absorbed by sea-water are functions of the temperature. Nitrogen varies within the same limits in deep and shallow waters; oxygen is generally present to a smaller extent than the hypothesis of surface absorption of atmospheric air, at the temperature corresponding to the amount of nitrogen found, would demand; and the absolute amount of oxygen in waters of great depths, and occasionally in waters of only moderate depths, is often exceedingly small.

Professor Dittmar discusses his analyses with great elaboration, and devotes much space to chapters upon the salinity and specific gravity, bromine, carbonic acid, alkalinity and absorbed gases of ocean-water. In the analysis the desirability of preciseness was constantly in view. Thus, for example, much stress is laid on the necessity of *weighing* portions for analysis, as is usual with concentrated mineral waters; and, in the estimation of total halogen by Volhard's method, Professor Dittmar secures greater accuracy by *weighing* the precipitating solution of silver nitrate, and then effecting the final titrations with centesimal solutions of ammonium sulphocyanate and silver nitrate. It is quite plain, however, and much to be regretted, that the lack of water at Professor Dittmar's disposal (never exceeding, and often falling short of, two litres) has affected the value of the work. Very few processes of analysis can bear the magnifying of inherent error a hundredfold; and 10 cm^3 of sea-water, to which Professor Dittmar felt restricted for single determinations of total halogen, is an exceedingly small portion when the result is to be expressed in grams to the litre of water, or in parts to the hundred grams of total salts. With an adequate quantity of material at hand, 40 cm^3 need not have been made to serve for a determination of lime and magnesia; nor would such processes as the estimation of magnesia as pyrophosphate, and sulphuric acid as barium sulphate, have been denied ordinary care to insure the purity of the substance weighed. In the case of the lime, it was found, when some of the residues of analysis were combined and tested, that the average error amounted in one set of thirty determinations to eight per cent, and in another series of twenty-six to nine per cent, of the total. With so large a margin of error, the application of the mean correction to individual determinations, as well as to the determinations of a series of twenty-one, the residues of which were not available for examination, is fraught with too much uncertainty. The difference, for example, between the corrections of eight per cent and nine per cent, would amount to nearly three times the difference which Professor Dittmar finds between surface and bottom waters as regards their contents of lime. Fortunately, Professor Dittmar's interesting conclusion concerning the distribution of lime in ocean-water does not rest upon the individual determinations alone, but depends upon his results with the mixtures of 'surface,' 'intermediate,' and 'deep-sea' waters, which allowed him ten times the material for an analysis which he had previously employed, and permitted the adoption of proper precautions.

Professor Dittmar's report closes with some very pertinent suggestions as to future work.

Part ii. contains Mr. J. Y. Buchanan's record of something like fifteen hundred hydrometric determinations of the specific gravity of waters from various parts and different depths of the ocean, and several plates illustrating the variation of density over the surface and in depth. It appears that the waters of the open ocean vary in density between the limits 1.02780 and 1.02400, pure water at 4° C. being taken as the standard.

In part iii. Staff-Commander Tizard tabulates the deep-sea temperatures, and shows, by the method of co-ordinates, the manner in which temperature varies with depth for each station of observation. Tables summarizing the observations, grouping and averaging them by localities, are appended.

The discussion of the records of part ii. and part iii., together with the meteorological data of the expedition, is in course of preparation by Professor Tait and Mr. Buchan.

PUBLICATIONS OF THE NAUTICAL ALMANAC OFFICE.

In the first part of this volume, Professor Newcomb presents a detailed development of the perturbative function which is applicable to all cases, except extreme ones, in which a general development of planetary inequalities in terms of the time is sought, and by which any required derivatives of the function may be found with great facility. In order to afford some idea of its range of application, he compares this development with others having the same general object; viz., those of Laplace, De Pontécoulant, Peirce, Leverrier, Hansen, and Cauchy. The method of this development has previously been indicated by Professor Newcomb, in the *American journal of mathematics*, vol. iii. The second part of this volume of the 'Astronomical papers' (pp. 201–344) is a determination of those inequalities of the moon's motion which are produced by the figure of the earth, and is by Dr. G. W. Hill, assistant in the office of the *Nautical almanac.*

In Delaunay's 'Théorie du mouvement de la lune,' the perturbations of the moon by the sun were fully treated; but subordinate portions of the theory were in some cases unfinished, and in others untouched. Having waited more than ten years for the promised filling of these gaps by French astronomers, Mr. Hill has in this paper taken up, in his masterful way, the discussion of the perturbations which the moon undergoes on account of the figure of the earth, the appreciable character of which was first brought to light by the analysis of Laplace. In his 'Darlegung der theoretische berechnung,' etc., Hansen has dealt with these inequalities in a very thorough way; but Mr. Hill has investigated these perturbations to the same degree of algebraical approximation that Delaunay adopted in determining the solar perturbations, viz., to terms of the seventh order inclusive; and his memoir is thus most appropriately entitled 'A supplement to Delaunay's theory of the moon's motion.'

The third part of the same volume (pp. 345–371), by Professor Newcomb, treats of the motion of Hyperion. In several papers published during the past five years, Professor Asaph Hall has shown a remarkable retrograde motion in the peri-Saturnium of its orbit, the period of its revolution being about eighteen years. At first sight, this result appears inconsistent with the law of gravitation; for it is easily shown that in the case of a body moving in an eccentric orbit, and disturbed by another moving in a nearly circular one, the secular motion of the peri-centre will always be direct. As Titan is much the brightest, and much the nearest to Hyperion, of all the satellites of Saturn, Professor Newcomb investigates the results of its attraction upon this satellite, and shows that the ordinary theory of secular variations is entirely inapplicable to the mutual action of these satellites, and that we have here an entirely new case in celestial mechanics. The ordinary theory of secular variations presupposes that the mean motions of any two bodies to which it is applied are incommensurable; so that to any given mean longitude of the one, will correspond, in the course of time, every mean longitude of the other. The conjunctions of the two bodies will thus be scattered through every part of the orbit. But four times the mean motion of Hyperion is nearly equal to three times that of Titan; so that, if the two satellites are in conjunction at a given time, when Hyperion has completed three revolutions, Titan will have completed four, and another conjunction will occur at very nearly the same point. In its outer form, this relation between the two satellites is somewhat analogous to that among the satellites of Jupiter; but it is quite different in its cause. Professor Newcomb develops the modified formulae applicable to this case; and among other results of interest is the determination of the mass of Titan equal to $\frac{1}{12500}$ part that of Saturn.

Astronomical papers prepared for the use of the American ephemeris. Vol. iii. parts i.–iii. Washington, *Government*, 1884. 371 p. 8°.

FORCHHEIMER'S TUNNEL-BUILDING IN ENGLAND.

Dr. Forchheimer visited England in the spring of 1883, by ministerial authority, to inspect and report upon the class of engineering work represented by the title below, confining himself, for the most part, to tunnels in progress or recently completed. Several most instructive examples are to be seen there, and

Englische tunnelbauten bei untergrundbahnen, sowie unter flüssen und meeresarmen: ein reisebericht. Von Dr. Philipp Forchheimer, ingenieur, privatdocent an der königl. technischen hochschule zu Aachen. Aachen, *Mayer*, 1884. 8 + 69 p., 14 pl. 8°.

engineers of other countries can learn much from their study.

He first describes and illustrates the method of constructing the portion of the London underground railway between Aldgate station and the Mansion house, by the way of the Tower. The difficulties encountered from gas and water pipes, sewers, and foundations of buildings, and the necessity of providing for the continuance of street-traffic, called for ingenious contrivances, by means of which the construction was successfully carried forward. Beton or concrete was used for the invert, beton or brick for the side-walls, and brick arches covered the top. All varied in thickness to suit the circumstances of the case, and the superincumbent load.

Next follows an account of the building of a tunnel in London for the Midland railway, with illustrations of the timbering employed in the work, and the tunnel cross-section found best adapted to resist the pressure of the London clay. A brief description of a contemplated subway under the Thames at Woolwich is then given.

The tunnel under the Mersey, between Birkenhead and Liverpool, a little less than a mile long, communication between the ends of which was opened early in 1884; and the Severn tunnel, not far from Bristol, to be four miles and a half in length, and now well advanced, — occupy in description about one-half of this report. The drainage-tunnel below the main tunnel under the Mersey; the arrangements for pumping and ventilation; the introduction of Col. Beaumont's machine, which had previously bored five thousand linear yards through chalk in the proposed tunnel under the English Channel, and here bores a hole seven feet in diameter through the sandstone rock, — are well described. The Severn tunnel is prosecuted with drills driven by compressed air. Progress has been hindered from time to time by the influx of water, even to the extent of completely flooding the works. The pumps required are consequently very powerful, having a capacity of eighty-two thousand six hundred cubic metres in twenty-four hours.

With the exception of two pages devoted to an intercepting or trunk sewer at Brighton, the closing pages are devoted to an account of the examinations and investigations already made in regard to a tunnel under the English Channel, between Dover and Calais, the present state of the project, and the possibilities of the scheme.

The book is handsomely printed, and the illustrations are very clear and explicit.

NOTES AND NEWS.

IN a lecture at Johns Hopkins on the place of the science of hygiene in a liberal education, Dr. Billings states the objections to the establishment of such a course, as follows: first, that there is no existing demand on the part of students for it; second, that the subject is not yet on a scientific basis; third, that the present courses of instruction given in the chemical, physical, and biological departments of the university, include all that a well-educated man need know of this subject, unless he proposes to make it a specialty; fourth, that the students have no time for any studies additional to the course already supplied. To the first objection Dr. Billings replied, that the same might be said as to other branches of the curriculum, — that the majority of students do not know what they ought to study, — and that the question is, whether the time has not come to create the demand, and for the university to lead the way in the matter. The second objection is only partly true. The general rule holds good in man, as it does in the laboratory, that like causes, under like circumstances, will produce like effects. When it has been shown in a number of well-marked cases that polluted water has been the means of spreading typhoid-fever, that overcrowding and foul air precede epidemic typhus, that scarlet-fever or diphtheria has been conveyed to a village by infected clothing from a distance, we have enough information to enable us to advise in similar cases, although we also know that men have drunk sewage with impunity, and that unprotected children have slept in the same bed with a scarlet-fever case and have not taken the disease.

— The foundations under the stone piers supporting the iron bridge, twenty-five feet above low-water level, by which the Wabash, St. Louis, and Pacific railway crosses the Kankakee River, have lately been giving trouble. The bed-rock of shale is hard and soft in places in the short space of a few feet. The three piers were built when the water was high, and were placed on platforms of four thicknesses of pine timber twelve inches square. Before these platforms were located, some of the loose material was removed; but it would appear that the foundation was dug deepest in the centre, and the rapid current of high water washed under and disturbed the piers. In order to fill the space, give a firm bearing over all the bottom, make the piers thoroughly durable, and at the same time not interrupt or interfere with the traffic over the bridge, the application of wooden wedges was suggested and carried out by P. E. Falcon of Chicago. By a strong jet of water and other appliances, the sediment and loose material were cleared away by divers from under two timbers at a time, and the bed-rock was cut away to a level. Oak timbers were fitted to the cavity; and a double row of broad oak wedges, to insure a complete bearing from the middle of the pier to the outside edge, was driven between the oak timbers and the pine platform by means of a steel bar weighing eight hundred pounds, suspended from the bridge by wires, and adjusted to

strike the heads of the wedges. The wedges, when all in place, were driven in the proper order to bring the pier back to its original position, and were then fastened by iron spikes driven by a ram-rod dropped through a gas-pipe as a guide. The work was done on the three piers by three divers in ninety days, and three hundred wedges were used.

— On an obscure passage in the Koran, Mr. W. T. Lynn, late of the Royal observatory, Greenwich, writes as follows: "In reference to Sir George Airy's letter in the *Athenaeum*, suggesting that the famous passage in the fifty-fourth Sura of the Koran does not relate to any phenomenal or supposed miraculous appearance in the moon, but to the ordinary semi-lunar phase when she is said, in the language of astronomers, to be dichotomized, perhaps I may quote Mr. Rodwell's rendering of the passage: 'The hour hath approached, and the moon hath been cleft. But if *the unbelievers* see a miracle, they turn aside and say, "magic that shall pass away." And they treat *the prophets* as impostors, and follow their own lusts; but every thing is unalterably fixed.'

"This hardly reads like a reference to an ordinary appearance of the moon as a chronological datum. The 'unbelievers' could surely not speak of that which occurs every fortnight as 'magic;' though many might conclude from previous experience that a peculiar appearance, produced by some meteorological condition, even though of a more remarkable kind than they had seen before, would pass away, and had no prophetical meaning. As to the expression, 'every thing is unalterably fixed,' Mohammed would probably mean that even miracles took place, like ordinary phenomena, by divine appointment. Mr. Rodwell, like Sale, thinks the word translated 'hath been cleft' may mean 'will be cleft,' the future 'being expressed by the prophetic preterite, and the reference being to one of the signs of the last day.' Nevertheless, he admits that the passage may refer to a miracle said to have been wrought by Mohammed; and this is, I believe, the general impression of Mohammedans with regard to it. I well remember travelling many years ago to Oxford with an Egyptian who had some scientific acquaintance with astronomy, and was at the time visiting the English observatories; and, on my remarking that Mohammed laid no claim to miraculous powers, he exclaimed, 'Oh, pardon! il a fait des miracles; il divisa la lune en deux parties, et puis' — Here my companion broke off his own sentence with a hearty laugh, sufficiently indicating his own scepticism of the alleged miracle. He was evidently about to refer to the later accretions of the story with which I was familiar as given by Gibbon from Maracci ; but he gave the Koran as his authority, and his primary reference was undoubtedly to the passage quoted by Sir George Airy."

— The Swedish academy of sciences has recently published the results of the measurements of the level of the Baltic, begun in 1750, to decide the controversy on the point between Celsius and the German scientific men of his day. The verdict of these hundred and thirty-four years is that both parties were right, and both were wrong. The Swedish coast has been steadily rising, while that along the southern fringe of the Baltic has been as steadily sinking. The dividing-line, along which no change is perceptible, passes from Sweden to the Schleswig-Holstein coast, over Bornholm and Laland. The northern part of Sweden has risen about seven feet. The rate of elevation gradually declines as we go southward, being only about one foot at the Naze, and nothing at Bornholm, which remains at the same level as in the middle of the last century. An example will best illustrate the process. The cliff near Pieta, known as 'Stora Reppen,' was, in 1851, ninety-three centimetres higher above the water-level than it was in the year 1750; and on the 12th of August, 1884, it was found to be about fifty centimetres higher than in 1851, showing that the rate of elevation had been quickened during the thirty years immediately preceding. The general average result would be that the Swedish coast has risen about a hundred and forty-three centimetres (nearly fifty-six inches) during the last hundred and thirty-four years.

— Writing to *Kosmos* from the Brazilian province of Rio Grande do Sul, Dr. H. von Ihreng, in regard to a case of polydactylism in a horse, which came under his own observation, says he has scarcely spoken to any one, who has travelled much in that region, who has not himself met one or more cases of the kind. The extra toes are on the inner side of the fore-feet. The question, he says, forces itself upon one, whether there has not been a survival of the old race of Equus in a few regions, which has escaped the notice of the discoverers and early settlers of the country. "The horse certainly still existed in the Rio Grande during the pleistocene era, as I have received horse-teeth from alluvial soil which were found in digging a well, and which agree in the very slightest details with the corresponding teeth of Equus Caballus. It is possible that among the wild horses of South America there are still to be found descendants of the native horses of the alluvial."

— Human skulls and other bones were lately dug up from the kjökkenmöddings at Muyem, near the Tajo, Portugal, which, judging from the character of the deposits and accompanying fauna, can almost with certainty be ascribed to the quaternary epoch. The earlier race was dolichocephalic. To this belonged a number of skulls of wonderful uniformity, offering so few differences, except of a sexual character, that we have unquestionably to do here with a homogeneous race. The prognathism of the skulls, and the length of the fore-arm, such as is only met with among negroes, recall at once the African races; while the capacity of the cranium is so small that it can be compared only with that of the Australian. There are also but few races of so small stature as these old inhabitants of Portugal. Only three brachycephalic skulls were found; and, judging from the organic marks, these belonged to a larger race than the dolichocephalic.

SCIENCE.

FRIDAY, FEBRUARY 6, 1885.

COMMENT AND CRITICISM.

That a wide-spread dissatisfaction with the past management of the U. S. department of agriculture exists, is obvious; but, beyond the somewhat puerile scheme for improving the department by a change of name and an access of official dignity to its chief, public discussion has been mainly confined to a consideration of the merits of various candidates for the position. A noteworthy exception to this rule is to be found in an article in the *Pacific rural press* of Jan. 3, by Prof. E. W. Hilgard of the University of California. This article is an abstract of a longer article by the same author in the *Atlantic monthly* for May, 1882, and is especially timely at the present moment. The gist of Professor Hilgard's proposition is to make the office of commissioner of agriculture less, and not more, of a 'political' office, than at present, or rather to remove it from politics altogether. Instead of a cabinet officer, changing with each administration, if not oftener, he would have him "a technical expert, not only responsible to the government, but amenable to that rigorous and incorruptible tribunal constituted of his scientific and technical compeers, and under the standing menace of a loss of his professional reputation, which no whitewashing committees, in or out of congress, could in any manner condone or undo."

We pass over Professor Hilgard's many other excellent suggestions regarding the management of the department, because this one appears to us to be the one fundamental reform which is needed, and which, if once secured, would be followed by the others as naturally as daylight follows the dawn. The coast and geodetic survey, and the geological surveys, have shown what government organizations can accomplish when divorced from politics, and directed by competent professional men holding office during 'good behavior.' The interests of agriculture are second to none in our country in magnitude, or in the novelty and difficulty of the problems presented. In no direction could a thorough knowledge of the art and science of agriculture find a wider or more attractive field for its exercise. In the interest alike of agricultural science and of practical agriculture, we hope that Professor Hilgard's suggestions may be speedily realized, and that the office may be rendered attractive to the class of experts from among whom it ought to be filled, but who, under the present condition of affairs, are neither thought of for the position, nor could afford to accept it if asked.

We have a prize offered by an American, one who would be known as a Good Samaritan, no doubt; and this prize, offered as it is for the discovery of a new comet or asteroid, has two singular conditions attached. First, the discoverer may not be of the continent of Europe. This condition is singular. Does not the European buy the wares of the Good Samaritan, or is it that the most successful seeker for little planets is a resident of the European mainland? It would seem that in the community of scientific men it would be as well that a Frenchman or an Austrian should have the honor, and should be encouraged as much in the discovery of a little ball of wandering rock, or of a comet, as that an Englishman, or an American, or a South-Sea Islander should have his ambition for scientific glory stimulated by the hope of a prize. Still there can be no serious objection to the giver limiting the competitors for a prize as he may see fit.

A second condition carries with it some dangers. The discoverer must, without notice to others, send word to the director of the ob-

servatory which our Good Samaritan has seen fit to establish; and only then shall the discoverer make his observation generally known, when he shall have received acknowledgment from the director mentioned. Now, it is important for the proper observation of any new wanderer that the news of it should be sent about the world without delay. The earliest observations of a comet are of especial value in fixing its orbit, and may, with bad weather or other mishap, be the only ones. A well-organized system for the collecting and transmitting of such information exists, and it is surely to be regretted that any condition should be attached to a reward which shall interfere with the benefits to be derived from the success of the worthy investigator. Such a condition is that which requires the competitor for a Warner prize to send word to Rochester before he can give the information to the International association of observatories.

Every worker in a special field of scientific or technical study must from time to time feel depressed under the difficulty, indeed too often the impossibility, of keeping himself well informed on what the world is accomplishing even in his own narrow department; so rapid is the succession, and so wide the separation, of papers and books treating of his subject. At such times he can appreciate the value of well-prepared current bibliographic records. The geographer turns to the monthly lists in *Petermann's mittheilungen*, or to the annual one published by the Berlin geographical society; the geologist has the *Neues jahrbuch*, and would gladly refer to the *Geological record* if it would only continue to appear in as good form as it began a few years ago; the zoölogist has his *Anzeiger*, *Record*, and *Jahresbericht;* and the chemist and the physicist are equally well cared for. But these extended lists are matters of provocation to many persons who cannot reach the books they name: for them a record is better suited that limits its selections by place instead of by subject, and gives a list of all kinds of publications on a certain geographic field. Two of these are mentioned in our notes, and both suggest the value of a similar work for our own country. The scope of such a volume would be sufficient for the purposes of many of our readers, if it included a record of the title, and a brief mention of the contents, of every thing written concerning our physical and natural history year by year. If undertaken by a number of specialists, the work would not be too laborious, and it would surely find publisher and purchasers. Why should not the Smithsonian institution undertake it?

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Anthropos and anthropopithecus.

I am glad that Professor Haynes, availing himself of my references, has refreshed his memory on de Mortillet. He will not again confound the age of St. Acheul with the axe of St. Acheul; and he and other readers of *Science* will now be aware that de Mortillet teaches that not man (the *anthropos*), but the man-ape (the *anthropopithecus*), was the representative of our species during most of the paleolithic period.

But why does the learned reviewer confine himself to the passages I pointed out to him? Why did he not turn to de Mortillet's work (p. 104), where he says, "L'homme quaternaire ancien n'était pas le même que l'homme actuel"? And where in the geologic horizon does de Mortillet place the arrival of *l'homme actuel?* Let any reader turn to the table of contents of the volume, and he will find that it is divided into three parts: 1. L'homme tertiaire; 2. L'homme quaternaire; 3. L'homme actuel. The last mentioned arrived, says the author, after a long and unexplained hiatus, *with the period of Robenhausen* (p. 485). Only in that period does de Mortillet concede to man his distinctive psychological traits of a language and a religion. Speaking of the very last of the Magdalenian period, he says, "L'homme quaternaire était complétement depourvu du sentiment de la réligiosité."

D. G. Brinton, M.D.

Dr. Brinton seems to be unfortunate in understanding de Mortillet's opinions, as well as in quoting his language correctly. Owing to the exigencies of space, 'the readers of *Science*' must be referred to the book itself, where they will find it stated that there is no conclusive proof that funeral practices prevailed in western Europe in quaternary times, and that such usages came into vogue there in the neolithic period. *Hinc illae lacrymae!* This is the sole foundation for Dr. Brinton's monstrous assertion "that de Mortillet teaches that not *man*, but the *man-ape*, was the representative of our species during most of the paleolithic period." De Mortillet's real views will be found summed up on the last page of his work, in twelve 'general conclusions,' so clearly and tersely 'that he who runs may read.'

Henry W. Haynes.

[A translation of this summary will appear in our next issue. — Ed.]

The Yellowstone Park as a bison preserve.

Permit me to thank you for your timely remarks in No. 103 upon the threatened extinction of the American bison. The question seems to be, as you state it, whether the bison (and with equal propriety, say I, a large number of other decadent types) can be successfully domiciled within the boundaries of the Yellowstone Park. Having given this subject careful attention, I am prepared to say that the practicability of the scheme admits of no reasonable doubt. The park itself is to-day one of the few regular retreats of the existing herds of buffaloes, and nothing but the protection intended by the laws is really needed for their preservation. Of late years much has been done by the superintendent and his efficient corps of aids, vigorously seconded by the territorial authorities of Wyoming. But the laws are not yet sufficiently punitory, and there is no provision for insuring the retention of the animals within the limits of the reservation. The superintendent, in a late report, refers to the presence of a few straggling bands at various points in the park, but apparently he considered them more as 'stragglers' than as legitimate denizens.

If the end in view, as suggested above, be the fostering of all animals which the national park may readily sustain, much more vigorous effort is demanded. The importation and semi-domestication of such exogenous forms as are in imminent danger of extinction should be encouraged; and why may we not look with great expectations upon such local scientific societies as are already organized in Denver and San Francisco? I have never seen a specimen of the Aplocerus montanus, nor have I met any one who has known it in its native haunts; but it is not wholly extinct. This species of antelope, incorrectly called the Rocky-mountain goat, should be preserved in the park, at all hazards. The big-horn (Ovis montana) is still living in Colorado and elsewhere; but it cannot long withstand the ravages of the hunter and the inroads of the mining industry. There is a very short lease of life for the grizzly bear under present conditions, and the beaver is rapidly disappearing.

Fortunately for our object, most of these animals have wandered into the park, and but little care will be required to retain them within its borders. Still there is needed some more capable and responsible supervision than has yet been secured by legislation; and experience has shown the influence which men of science have been able to exercise in similar cases. A committee of the American association for the advancement of science, appointed at the Nashville meeting, was able to obtain an appropriation from congress of ten thousand dollars, to be applied to the increase of accessibility to the geysers and thermal springs; and quite recently more has been done in that direction, and in the way of stopping lawlessness and depredations. Now is the time, and scientific men are the legitimate instruments, for completing the work by united action in support of this vast zoölogical garden, and of the collection of representatives of the many dying forms of our American fauna. Theo. B. Comstock.

Cleveland, O., Jan. 27.

The muskrat carnivorous.

Some twenty years ago, and from that time on for ten years, I was in the habit, with some friends of similar tastes, of closely searching the river-banks of this vicinity, and the waters, too, when practicable, for the aquatic mollusks which then abounded. The muskrats, now nearly extinct among us, were then numerous; and we soon learned that they were excellent collectors of shells, bringing out great numbers of the deep-water mussels of several species not usually very easily found by us, and leaving the shells in perfect condition.

In the rocky banks were many caves where shells were thus gathered; and one, especially on the south bank of Rock Island, a large space, well sheltered, and above high water, contained many bushels, — the accumulations, apparently, of a long period, but very fresh in appearance, and well preserved. Among the species most numerous were Unio cornutus, U. metaneorus, U. securis, and U. pustulosus. Many other species were found in less numbers, — U. rectus very rarely (though numerous in the river), and U. monodontus never. These heaps we examined with the utmost care, and obtained hundreds of fine specimens. During those years the muskrats still inhabited these places, and, except in winter, constantly brought out quantities of fresh shells, which we conscientiously appropriated. It was also very common to find heaps of fresh shells on or beside a stump, log, or rock, a few feet, or sometimes rods, from the water. We not infrequently found shells which had been gathered since the preceding day, as shown by shreds of the soft parts adhering to the shell being undried.

An open question with us, often asked but never answered, was, 'How do the rats open the mussels?' The first attempt at an explanation, which I remember to have seen, was in the remarks of Mr. W. S. Lee at a meeting of the Trenton natural-history society (*Science*, vol. iv. no. 94, p. v.).

Of course, we cannot gainsay what Mr. Lee has *seen*, that the animal 'apparently' held the mollusk's foot with his claws, preventing the closure of the shell. It would perhaps require a pretty strong grip to counteract the force of the powerful adductor muscles of the mollusk, with the pressure of the rat's paws at the same time tending to *press the shell together*. Again: one cannot help wondering how "the muskrat swam ashore, holding the mussel between the fore-paws," while the weight of the mussel would tend to pull the animal's head down, and, without the use of the fore-paws, how he could swim. We also wonder how, without relaxing his grip, he carried his burden, as was usually the case, to some distance from the water.

In *Science*, vol. v. p. 65, Mr. W. M. Beauchamp gives some curious explanations. He does not state where he saw "the statement that the carnivorous habits of the muskrat have but just been discovered by scientific men." Of course, everybody who knows the muskrat at all has always known that it is not worth while to bring proof of a fact so universally known.

"The four principal ways in which the muskrats get at the animal in the mussel-shell" may deserve a moment's attention. 1°. In our experience, the Anodons among the muskrat-heaps were very rare: they evidently preferred Unios; and in no instance were the Anodons in the shell-heaps found in a condition indicating that one valve had been torn off to open it. It was not uncommon to find, just along the water's edge, the tracks of the raccoon; and along these tracks were often to be found the Anodons, with one shell torn off or crushed. The coon seemed to prefer the Anodon, probably having no means of opening the Unio. 2°. The Unios were *never* observed with 'the thinner end of the shell,' or either end or edge, broken away. 3°. While he 'has heard' that the rats sometimes gnaw away the hinge-liga-

ment, it was a matter of common observation with us that such an instance *was absolutely never met with.* Among thousands, and hundreds of thousands, the ligament was always preserved intact. 4°. As to the astute creature 'allowing the animal to freeze and open,' we will not attempt to question that. It may occur to some readers that it would be rather monotonous for the hungry rat to wait during the hot summer nights (even at 'the west and *south*') for the stupid mussel to 'freeze and open.' That, however, is his business, not ours. W. H. PRATT.

Davenport, Io., Jan. 28.

THE GEORGIA WONDER-GIRL AND HER LESSONS.

THE people of the interior states are now being amused by an exhibition the success of which offers a striking example of the unreliability of human testimony respecting the phenomena of force and motion. Some months since, the writer received a polite invitation to witness the wonderful performances of Miss Lulu Hurst, the Georgia 'magnetic girl,' in causing objects to move as if acted on by powerful forces, without any muscular action on her part. Another engagement prevented his acceptance; but, on the morning following, he received such a description of the phenomenon as to make him regret that he had not sacrificed every thing to the opportunity of seeing it. It was substantially this: —

A light rod was firmly held in the hands of the heaviest and most muscular of the select circle of spectators. Miss Lulu had only to touch the rod with her fingers, when it immediately began to go through the most extraordinary manoeuvres. It jerked the holder around the room with a power which he was unable to resist, and finally threw him down into one corner completely discomfited. Another spectator was then asked to take hold of the rod; and Miss Lulu, extending her arms, touched each end with the tip of a finger. Immediately the rod began to whirl around on its own central line as an axis, with such rapidity and force that the skin was nearly taken off the holder's hands in his efforts to stop it. A heavy man being seated in a chair, man and chair were both lifted up by the fair performer pressing the palms of her hands against the sides of the back. To substantiate the claim that she herself exerted no force, the chair and man were lifted without her touching the chair at all. The sitter was asked to put his hands under the chair: the performer then put her two hands around and upon his in such a way that it was impossible for her to exert any force on the chair except through his hands; yet the chair lifted him up without her exerting any pressure heavier than a mere touch upon his hands. Several men were then invited to hold the chair still. The performer began to deftly touch it here and there with her fingers, when the chair again began to jump about in the most extraordinary manner, in spite of all the efforts of three or four strong men to keep it still or to hold it down. A hat being inverted upon a table, she held her extended hands over it. It was lifted up by what seemed an attractive force similar to that of a magnet upon an armature, and was in danger of being torn to pieces in the effort to keep it down, though she could not possibly have had any hold upon the object.

This was the account of the performance given, not by a gaping crowd nor by uncritical spectators, but by a select circle of educated men. To the reminder that no force could be exerted upon a body except by a reaction in the opposite direction upon some other body, and to the question upon what other body the reaction was exerted, the narrators expressed themselves unable to return an answer. All they could do was to describe things as they had seen them. Of only one thing could they be confident: the reaction was not exerted through or against the body of the performer. Among the spectators were physicians and physiologists who grasped Miss Lulu's arms while the extraordinary motions went on without finding any symptoms of strong muscular action, and who, feeling her pulse after the most violent motions, found that it remained in its normal state. Apparently the objects which she touched were endowed with a power of exerting force which was wholly new to science. Altogether, the weight of evidence seemed as strong as in the best authenticated and most inexplicable cases of 'spirit' manifestation, while none of the obstacles to investigation connected with the latter were encountered.

Such was the case as it appeared on a first trial; but the spectators were not men to be satisfied without further investigation. Accordingly, they had made arrangements with the managers to have another private exhibition at the Volta laboratory two days later. They proposed also to have decisive tests to determine whether or not she exerted any force upon the objects which she moved.

The party duly appeared at the appointed time. At this point I think it only just to mention the perfect frankness with which the most thorough investigation of the case was permitted by those having the exhibition in

charge. There was no darkening of rooms, no concealing hands under tables, no fear that spirits would refuse to come at the bidding of a sceptic, no trickery of any sort. The opportunities for observation were entirely unrestricted.

Miss Lulu was a rosy country girl, somewhat above the average height, but did not give the impression of muscular training; still, when she was presented to those present, the first thing which struck the writer was the weight of her arm. Shaking hands with her felt like moving the arm of a giant, and led to the impression that she had a much better muscular development than would have been supposed.

Before proceeding to the tests which had been pre-arranged, it was thought best to try what she could do under ordinary circumstances. Among the first performances to be tried was that of the hat. A spectator held a light straw hat in his hands, the opening upwards. Miss Hurst extended her hands over it so that the balls of her thumbs just touched the inner face of the rim. At first there was no result, but after a few trials the hat was gently attracted upwards as if by electricity. Had those in charge been professionals, I cannot doubt that they would have stopped right there, and declined to repeat the performance. Not being such, they yielded to the invitation to go on, so that the holder could see how it was done. This was soon effected without difficulty. Whenever the apparent attraction was exerted, it was through the inner edge of the brim being caught in the fold of the ball of the extended hand. After a few moments the observer was enabled to say, "She cannot lift it now, because her hand is not rightly arranged," and he learned to adjust her hand so that the lifting could be executed. Of course, the force was not very strong. The idea that the hat would have been in any danger had a weight been in it was simply a mistake.

Next the jumping-staff was tried. The writer took the latter in his hands, and Miss Lulu placed the palm of her hand and her extended thumb against the staff near its two ends, while the holder firmly grasped it near the middle. He was then warned to resist with all his force, with the added assurance that the resistance would be vain. Sure enough, the staff began to be affected with a jerking motion, producing the disastrous effects which had been described upon the holder's equilibrium. An unwise repetition of the performance, however, did away with all its mystery; for, although the performer began with a delicate touch of the staff, the holder soon perceived that she changed the position of her hands every moment, sometimes seizing the staff with a firm grip, and that it never moved in any direction unless her hands were in such a position that she could move it in that direction by ordinary pressure. An estimate of the force which she exerted on the staff could be roughly made. It might have been as high as forty pounds. A very little calculation will show that this would be sufficient to upset the equilibrium of a very heavy man. It is impossible for the latter so to place his feet that he will be supported on a rectangle of more than one foot in breadth. He may indeed change at pleasure the direction of the longer side of this rectangle by extending his feet in different directions; but, arrange them as he will, his base will under any circumstances be a rectangle whose length is equal to the distance between his feet, and whose breadth is at the very maximum equal to the length of his feet. A pressure of one-fifth his weight would, under the most favorable circumstances, throw him off his balance, and make a new adjustment necessary. The motion given by the performer to the rod was not a regular one, which could be anticipated and guarded against, but a series of jerks, first in one direction, and then in another; so that it was impossible for the holder to brace himself against them: consequently, by a force which might not have exceeded forty pounds, he was put through a series of most undignified contortions, and finally compelled to retire in total defeat.

The holder of the rod then asked that it might be made to whirl in his hands in the manner which had been described to him. No attempt was made to do it, and no satisfaction on the subject could be obtained. It was evidently a simple mistake in memory or narration, for not even Miss Lulu seemed to have any idea of producing such an effect. The lifting of the chair with the sitter's own hands under it, and Miss Lulu's hands under his, was then tried. The simplicity of the blunder was most striking. It was quite true that the fingers of the performer were under those of the sitter. But the chair refused to budge until the ball of her hand came firmly in contact with it; and then it proceeded, not indeed to lift the sitter, but to incline itself in such a way that he felt compelled to get out of it. The chair was made to repeat its performance a great number of times. The writer watched most carefully, and, in every instance in which he was able to see the performer's hands at the time of the motion, the ball was pressed firmly against the

chair, and the direction of motion was that of the pressure.

Three men, or indeed as many as could get hold of the chair, were then invited to hold it still if they could. This was the most amusing and exciting part of the spectacle. The men tried in vain to hold the chair still, while Miss Lulu simply moved around in the quietest imaginable way, touching it with her finger first here and then there, until finally the force became so great that the chair began to crack, and seemingly almost pull itself to pieces. The explanation was, however, perfectly obvious. There was no concert of action among the four muscular holders, more than that each one tried to keep the chair still by resisting any force which he felt it to exert. A few jerks in various directions by the performer led them to begin resisting her motion by pulling the chair first this way and then that. It was of course impossible for any one holder to tell whether the motion came from the performer or from his companions. The result was, that they all began to wrench desperately against each other until the chair came to pieces.

The scientific tests were productive of the usual result, — that ghosts, spirits, and occult forces absolutely refuse to perform their functions in the presence of scientific paraphernalia. A platform had been placed on rollers in the middle of the room, and Miss Hurst was invited to set the rod in motion while she stood on that platform. Her parents were perfectly confident that she could do it, and she did go so far as to commence one feeble attempt; but the forces refused to operate, or rather the platform persisted in rolling about, and the attempt had to be given up. She then stood upon the platform of a pair of scales, the counterpoise of which was so adjusted, that, when she exerted a lifting-force exceeding forty pounds, the arm would be raised. A spectator sat in the chair in front of the scales. It was soon found, that, owing to the platform being some six inches above the floor, the chair was lower than she had been accustomed to have it: it was therefore set upon a little platform of the same height as that of the scales, so that the position was the same as if both stood on the floor. The performer pressed her hands against the sides of the back of the chair, according to custom. The motion was long in commencing, and, when it began to appear, click! went the lever of the scales, showing that a force of more than forty pounds was exerted. This seemed to demoralize the performer, and, notwithstanding a great deal of chiding from her parents, nothing more could be done while she stood in this position.

From various allusions in the public press, it would seem that the wonderful 'magnetic girl' has not yet ceased to draw full houses. The editor of the Chicago *Inter-ocean* made a careful investigation of the case, and showed that it could not possibly be electricity which caused the motion; but he does not essay an explanation of what the force was.

Although it would be unjust and pretentious to say that no one sees the absurdly simple character of the performance, it would appear that there are many who are mystified by it, and that, should we accept the existing testimony on the subject as complete, we should be compelled to admit that some new form of force had been discovered. It is indeed possible that the absurd simplicity of the affair may help to give it vitality; for, as already indicated, not only is there no mystery or concealment, but there is not even a resort to the tricks of legerdemain, which consist very largely in distracting the observers' attention at the critical moment. The assumption, that, because Miss Lulu begins by touching the articles deftly with her fingers, she never takes them with a firm grip, is one which the spectator takes upon himself without any effort on the performer's part to cause that illusion.

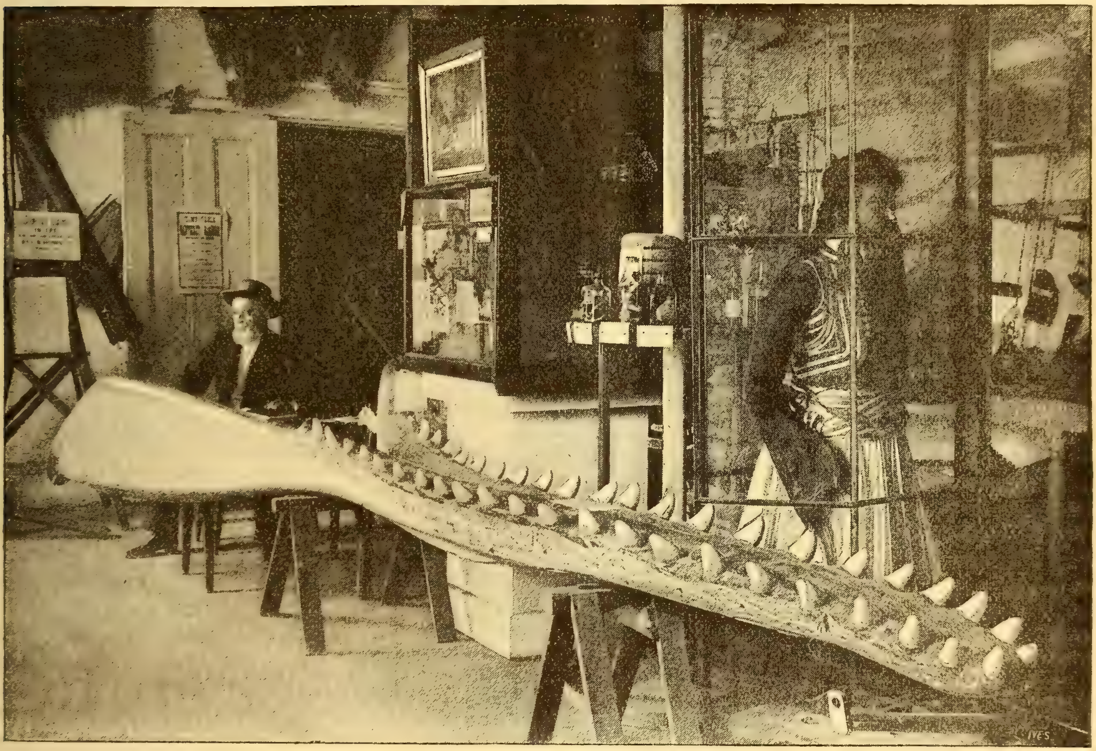
This account is presented to the readers of *Science*, because, taken in connection with descriptions of the performance given by thousands of spectators, many of them critical observers, it affords the basis of a reply to those who have seen chairs, tables, and pianos dance without human agency.

S. Newcomb.

THE NANTUCKET MUSEUM.

The little town of Nantucket, on the island of that name off the southern coast of Massachusetts, boasts a little museum *sui generis*. The first thing which strikes a visitor is the extremely heterogeneous character of its collections. It is certainly amusing to see, side by side with specimens of rare interest and scientific value, such entirely valueless things as pieces of melted glass from the Chicago fire, and bits of wood from the frigate Constitution; but most of the 'curiosities' have some local value, being connected with the past whale-fishery, and were collected by the whalemen of the town in their wide wanderings. Hanging on the walls, lying on the tables and even on the

floor, are savage implements and curiosities, which cannot fail to interest the visitor, especially as they are all explained by the curator, Mr. Murphy, who has thrilling tales to tell of each separate piece; nor is the curiosity-hunter the only person who is likely to be interested in this museum. In its collection of tropical shells, there are many which cannot be numbered among the commonest; but, for the naturalist, the one thing which possesses an all-absorbing interest is the sperm-whale's jaw, which extends nearly across the exhibition-room. The curator, who considers this his special pet, is full of enthusiasm for it, and claims that it is the only full-grown jaw of a sperm-whale in America. It was taken in 1865 by a Nantucket whaler in the Pacific Ocean, from a sperm-whale which measured eighty-seven feet in length and thirty-six feet in circumference, and had the enormous weight of two hundred tons. The whale gave forty-five hundred gallons of oil. The jaw itself weighs eight hundred pounds, measures seventeen feet in length, and has forty-six huge teeth. These are badly worn, and prove that the animal must have been very old. In connection with the jaw, Mr. Murphy describes the animal, tells about its enemy the whale-killer, its parasites and other pests, explains the process of killing the whale and cutting up and trying out the blubber, illustrating his talk either with the apparatus itself or with ingeniously made models. On the other side of the room is a small jaw twisted in a spiral direction, and bearing plain evidences of having been injured at an earlier stage. The teeth are long and somewhat slender, partly from the youth of the animal, partly from disuse. When taken, the whale was alive; but the lower jaw was badly aborted, and the animal was in a poor state. It must have been in this condition for years, and have lived upon what chanced to come in its way. It is to be hoped that the collection may always be well cared for, and may become more than now the nucleus of a good collection of the natural objects of Nantucket itself.



THE 'COMMA BACILLUS' OF KOCH.

DR. KOCH has himself stated in precise terms the nature of the proof required in order to es-

tablish in a definite manner the specific pathogenic power of a micro-organism, which, by its presence in the blood, tissues, or alimentary canal, may be supposed, *a priori*, to bear a causal relation to the disease with which it is associated.

This proof depends upon the production of characteristic morbid phenomena by inoculating susceptible animals with 'pure cultures' of the parasitic micro-organism previously found under circumstances to justify the supposition that it bears an etiological relation to the disease under investigation. This final proof Koch has attempted to obtain with reference to the so-called 'comma bacillus,' which, according to his observations, is constantly associated with epidemic cholera, and, after numerous failures, claims finally to have succeeded. In a late number of the *Deutsche medicinische wochenschrift*, he says, —

"The experiments of Rietsch and Nicati have been lately repeated at the Imperial board of health; a pure cultivation being so far diluted, that the amount injected contained scarcely a hundredth part of a drop of the cultivation liquid. The liquid was injected into the duodenum without previously binding the ductus choledochus. With few exceptions, the animals so treated died within a space of time extending from a day and a half to three days. The mucous membrane of the small intestine was reddened: its contents were watery, colorless, or slightly reddish tinged, and at the same time flaky. Comma bacilli were found in the contents of the intestine in a pure cultivation and in extraordinary numbers, so that the same phenomena were visible here as are seen in the cholera intestine in its fresh state. Owing to the small quantity of infectious matter used for injection, the idea of a simultaneous intoxication from poisonous matters contained in the cultivation liquid used for injection is excluded." [1]

In face of the previously reported failures to produce cholera in the lower animals, we are disposed to receive the proof now offered with some reserve, inasmuch as the injections seem to have been made through the walls of the abdomen directly into the intestine. This method has, no doubt, been adopted upon the supposition that previous failures were due to destruction of the bacilli by the acid juices of the stomach when they have been introduced by the mouth. There is nothing improbable in this supposition; but, on the other hand, the possibility that when the material is injected directly into the intestine the puncture made may have been a serious complication and source of error, at once suggests itself.

That micro-organisms closely resembling the 'comma bacillus' are to be found in the healthy human mouth, and in the discharges of patients with other forms of intestinal flux, cannot be doubted; but that these are identical with the 'comma bacillus' cannot be established upon morphological grounds alone. If one 'comma bacillus' in pure cultures produces cholera, and another having identical morphological characters does not, we must admit an essential difference — physiological — which, if constant, must be considered a specific character, equal in value to a constant difference in form or in color. If such difference is not constant, it will at least establish a pathogenic variety of the ordinarily harmless organism. But this is not the state of the question as regards Koch's 'comma bacillus:' for in his answer to Prof. T. R. Lewis of the English army medical school, who asserts that a curved bacillus, identical with the 'comma bacillus,' is found in normal human saliva; and to Professors Finkler and Prior, who claim to find similar organisms in the discharges of patients with cholera nostras (sporadic cholera), — Dr. Koch shows very conclusively that the organisms referred to are not identical with the 'comma bacillus,' although bearing some resemblance to it. This conclusion is based both upon appreciable morphological differences, and upon the different behavior of the organisms when cultivated upon gelatine.

Through the courtesy of Dr. Billings of the army, I have recently had an opportunity to study the morphology of the 'comma bacillus,' having had in my possession for several days a slide sent by Koch himself to the Army medical museum. My laboratory assistant, Dr. A. C. Abbott, has made for me a camera lucida drawing, which, I think, fairly represents the organism as seen in this slide, and which is reproduced in fig. 1. Each separate cell was drawn under the camera lucida; but the field as a whole is an ideal one, as I desired to show in a single figure all of the forms found in the slide. As a matter of fact, the 'commas' as seen at *a* are by far the most numerous, and are found clustered in groups and masses; while the characteristic spirilla, such as may be seen at the centre of the field at *i*, are comparatively scarce. Still, in view of the intermediate forms, as seen at *c*, I cannot doubt that we have here a pure culture of a single organism, and that this organism is in truth a spirillum, and not a bacillus. If one saw only such forms as we have delineated at *e*, there would be no hesitation in pronouncing them bacilli; and the name 'comma bacillus,' from a morphological stand-point, applies very well to the prevailing form, as seen at *a*. It is not sur-

[1] Quoted from the *British medical journal* of Nov. 22, 1884, p. 1036.

prising that at the outset Koch spoke of the swarms of rods, straight or slightly curved, which he found in the intestines of cholera patients as bacilli; and, indeed, the fact that these rods were capable of developing into spiral filaments could only be determined by protracted observations and by making pure cultures. It seems to me that some of Koch's critics, and especially Ray Lankester (see his paper in *Nature*, Dec. 25, 1884), are making altogether too much of this very pardonable mistake, which has no special bearing upon the real question at issue, and cannot weaken our confidence in the candor and scientific accuracy of a man to whom we are so deeply indebted, and whose scientific reputation is established upon a firm foundation.

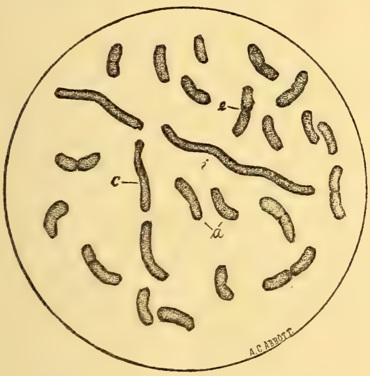


Fig. 1. — Comma bacillus (Koch) × 2,500 diameters.

Ray Lankester is unquestionably right when he says that our knowledge of the bacteria is still in its infancy; but, so far as this knowledge goes, it is doubtful whether any man living can speak with more authority than can the discoverer of the tubercle bacillus.

The amplification in the figures illustrating this paper is exactly twenty-five hundred diameters, and was obtained with admirable definition by the use of Zeiss's one-eighteenth inch homogeneous immersion objective upon a Powell and Lealand's large stand, with a high eye-piece, and the draw-tube extended one inch. The measurement was made by projecting the lines from a standard stage-micrometer, ruled by Professor Rogers of Cambridge, Mass., upon a sheet of paper in the exact position in which the drawing was made, by means of the same objective, eye-piece, and camera lucida. Fig. 2 was made in the same way, and represents curved bacilli, which resemble the 'comma bacillus,' and which are, perhaps, identical with those described by Prof. T. R. Lewis as found in the healthy human mouth. The specimen from which the drawing was made was one of sputum from a patient with pneumonia. I think it hardly necessary to insist that the bacilli in fig. 2 are not morphologically identical with the 'comma bacillus' of Koch as shown in fig. 1; and I may say here, that, during my somewhat extended bacteriological studies, I have never encountered an organism which seems to me to be identical with that seen in the slide above referred to. Should such an organism be found, it would not in the least weaken the experimental evidence relating to the specific pathogenic power claimed for this spirillum. But we must insist, in any case, that this experimental evidence shall meet the most rigid exactions of science. Certainly, Koch fully appreciates this, and is doing his utmost to comply with the conditions which he has imposed upon himself. We are therefore not able to sympathize with the captious spirit of some of his critics. Nor, in the absence of a detailed report, are we prepared to admit that the English cholera commission has definitely settled the question as to the etiological *rôle* of the 'comma bacillus' during the comparatively brief time which has been devoted to the investigation; and, in view of the contradictory testimony now before us, we cannot do otherwise than consider the question still *sub judice*, and wait patiently for detailed reports and additional experimental evidence.

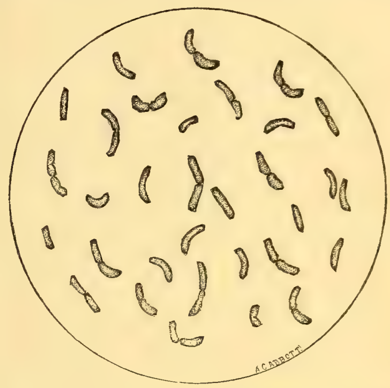


Fig. 2. — Bacilli found in pneumonic sputum × 2,500 diameters.

George M. Sternberg,
Surgeon U. S. army.

LIGHTHOUSE ILLUMINANTS.

A parliamentary document is not the place where one would naturally look for facts of scientific value: but, in a return published by the English house of commons on the 11th of December last, there is

much interesting information on the subject of lighthouse illuminants in the form of correspondence between the Board of trade, which has general supervision of the lights of Great Britain; the Trinity house, which manages the English lights; and the Commissioners of northern lights, who have control over those of Scotland.

It may be remembered that in 1883 it was proposed to make exhaustive tests of the relative value of petroleum, gas, and electricity, as illuminants for lighthouses, by comparing the several lights in actual operation together at the South Foreland station; and the lighthouse authorities of all three kingdoms had arranged to act conjointly in prosecuting the experiments. When, however, the conditions under which the trials were to take place were formulated, the representatives from Ireland considered that these would place the system favored by the Irish authorities — the Wigham gas system — at a disadvantage, and refused to take further part in the proceedings.

Dr. Tyndall, who had for years acted as scientific adviser to the Trinity house, but had prior to this resigned, then wrote certain letters to the newspapers on the subject. These letters appear, says the Board of trade, to assert the superiority of gas, as used in Mr. Wigham's burners, as a lighthouse illuminant; and, further, to imply that the engineer of the board, Mr. (now Sir James) Douglass, has not been entirely disinterested. The Board of trade therefore asked for a full report of the views of the English and Scotch lighthouse boards on the whole question; and their replies, which give a fair idea of the present state of development of illuminants adapted to this special purpose, may be taken to be the defence of the board against Dr. Tyndall's strictures.

From the learned professor's statement, it appears that in 1869, when he was sent to Ireland to make himself acquainted with the gas system of lighthouse illumination, colza-oil was used in the Trinity-house lamps; and this was superseded, at a vast saving to the country, by mineral oil. Mr. Wigham had succeeded in producing a gas-lamp superior in power to the best oil-lamp then extant. The gas-flame showed a promptitude of action and a pliancy of adaptation unattainable with oil. By a simple automatic apparatus, the gas-flame could be made to send forth flashes in any desired succession, and of any required duration. Long and short flashes could be combined so as to render the identity of a lighthouse unmistakable, or enable it to spell its own name by the Morse alphabet. Further, Mr. Wigham had surrounded his central 'bunch' with rings of burners, to increase the light in thick weather. In a few seconds a light-keeper could pass from 28 jets to 48, and thence with equal rapidity to 68, 88, and finally to 108 jets, all these flames being under the most perfect control. The best oil-flames then known were feeble scintillations, compared with the flame of the 108-jet burner. Dr. Tyndall adds to his own the testimony of many others as to the value of the Wigham system as then examined, and proceeds to describe a later visit to the lighthouse at Galley Head, which is now, he says, without a rival in the world. In this light the refracting-lenses of four first-order apparatus are fitted one above another in the same lantern, with a 108-jet burner in the focus of each apparatus. It had already been visited by the Elder brethren of the Trinity house; and their engineer's report, he claims, was the only one unfriendly to the light. In spite of the almost unanimous opinion in its favor, the Trinity house decided in favor of a six-wick burner consuming mineral oil (Sir James Douglass's patent). Finally, Sir James, says the doctor, recognized the merits of the gas system, and decided to adopt it, but for the extinction rather than with the co-operation of Mr. Wigham.

The Trinity house replies at considerable length, giving in full the result of its investigations into the worth of the Wigham light. From these observations, the Elder brethren derived an opinion that one prominent objection to it is, that the higher powers of the single burner are obtained by increasing its size. The diameter of the 28-jet flame is four inches and a quarter; that of the 48 is five inches and seven-eighths; and so on, until a diameter of eleven inches and an eighth is reached with the 108-jet burner. Then, as the prisms of the optical apparatus are adjusted to a focus within the confines of the small flame, it follows that a great portion of the enlarged flame is extra-focal, and distributed in directions not intended by the designer of the apparatus. This effect is not particularly important in a fixed light showing all around the horizon. By far the greater number of fixed lights, however, require to be either strictly confined in angular width, or marked with color within particular bearings, which is accomplished by interposing fixed vertical screens, opaque or of colored glass, close to the glazing of the lantern. Directly the diameter of the flame is enlarged, the screen will no longer cut off the light with precision on its appointed bearings: the ex-focal rays of white light will stray into the sector which should be dark or colored, and destroy the means of guidance for which the light is intended.

The diameter of the oil-burner being constant, and its flame more compact than the Wigham burner, — for instance, the six-wick oil-burner, four inches and three-eighths wide, being equal in power to the 48-jet gas, five inches and seven-eighths wide, — it follows that oil is, according to the facts before us, more suitable for important niceties of direction. Occultation — that is, the sudden and short eclipse, at regular intervals, of an otherwise continuous light — is effectively applied with either source of illumination, but in the Wigham system is applied to flashing lights in a novel manner, as an additional means of identification. A light showing one long flash every minute, is, by occultation at short intervals, made to show a number of short flashes instead of the long one. With a widening burner, the luminous beam becomes broader, and the number of flashes seen in each series becomes greater; so that the expansion of a burner involves a change in that distinctive character upon which the observer most relies. At Galley Head this uncertainty as to the number of flashes had been observed.

These considerations led the Trinity house to the opinion that the Wigham gas system in single form could in a very few cases be employed at its higher powers without risk of perplexing the mariner; that the highest power at which its single burner could be used under every required condition was also obtainable by oil; that its special novelties in distinctiveness, as introduced at Galley Head, would only be available at widely separated stations; and that where space and considerations of expense permitted the use of gas in triform or quadriform, electricity would also be admissible, and, by its suitability for optical treatment, would be better adapted for producing the effects required in coast illumination; and, finally, its own experience with the two gas-lighted towers at Hasborough was not such as to encourage a more extended application.

The Commissioners of northern lighthouses, in answer to the letter of the Board of trade, send a report from Messrs. Thomas Stevenson and J. A. Crichton, which, in the main, agrees with that of the Trinity house.

From the paper read by Sir James Douglass before the British association in Montreal may be gleaned a few facts as to the relative powers of the best lights now in use, which are not mentioned in the correspondence just described. He states that the first electric light used in an English lighthouse in 1858 was of 700-candle power, whereas an intensity of 50,000-candle units is now found to be practically and reliably available for the focus of an optical apparatus; so that, with regard to intensity, this luminary outstrips all competitors. Compact flames are now being produced from oils and coal-gas, having an intensity of 1,500 to 2,000 candles; while, with the 108-jet Wigham burner, an intensity of nearly 3,000 candles has been reached. With regard to economy, mineral oil has the advantage of all its rivals up to the maximum intensity at which an oil light is practicable, and has the further advantage over electricity or gas in its ready application at any station, however isolated, and in many cases where the use of the other illuminants would be impracticable. He proceeds to show that fixed lights are no longer to be considered trustworthy coast-signals, owing to their liability to confusion with other lights, and that the period of a light should not exceed half a minute; further, that time should not form an element in the determination of the distinctive character of a light. On the coast of England the Trinity house is converting all fixed lights to occulting, where local dangers are required to be covered with red sectors, or sectors of danger-light. For this the electric light is eminently adapted. In cases where this local mapping-out of dangers is not required, flashing lights, in consequence of their higher intensity, are being adopted.

Referring to the optical apparatus of the new Eddystone lighthouse, he describes it as consisting of two superposed tiers of lenses with a six-wick Douglass oil-burner in the focus of each. In this respect a part of Mr. Wigham's system has assuredly been copied. With a clear atmosphere, the lower burner only is worked at its minimum intensity of about 400-candle units, giving an intensity of the flashes of the optical apparatus of about 37,000 candles; but in thick weather the full power of the two burners is put in action, with an aggregate intensity in the flashes of the optical apparatus of about 159,000-candle units. This intensity is about 23 times greater than that of the fixed light latterly exhibited from the old tower, and about 2,380 times the intensity of the light originally exhibited in the same tower, at about the same cost, from tallow candles.

THE ESSEX DENEHOLES.

THE word 'denehole' means '*den*hole,' and is pronounced '*dane*hole.' Those of Kent and South Essex may be described as consisting of narrow vertical shafts leading to artificial chambers excavated in the chalk, their depth varying with the distance of the chalk beneath the surface. They are found singly, in groups of twos and threes, or in larger collections of perhaps fifty or sixty pits.

Our illustrations show two types of the varieties of form exhibited by deneholes. The beehive shape is especially common in the shallower pits, which are wholly, or almost wholly, in chalk. A drawing of a pair of such pits discovered in a chalk cliff at Crayford brickfields is given (fig. 1). Their depth was

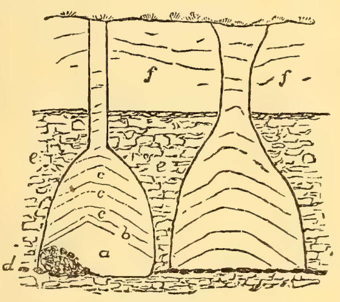


FIG. 1.

thirty-seven feet, and the greatest width eighteen feet. The walls showed no signs of metal picks, and the chalk blocks must have been prized out, but they were well and symmetrically worked. In one was a layer of very hard clay, washed into a cone at the bottom, and containing flint flakes, scrapers, and a 'core:' above that a layer of Roman pots and pans (a Samian dish, etc.) rested, followed by some very fragmentary and coarse potsherds and confused rubbish, apparently intended to fill the hole up to the surface of the ground. The sister-cave did not show an equal stratification of *débris*, and appeared to have fallen in at an early period.

Of the deeper deneholes existing in Hangman's Wood, one (fig. 2) is eighty feet deep. In three examples at Hangman's Wood (not figured) there were six chambers, while in two at Bexley only three chambers radiated from the shaft. A final stage in denehole evolution seems to have been the removal

of the greater portion of the partitions separating the chambers, pillars of chalk only being left to support the roof. The usual height of denehole chambers may be said to be from ten to twenty feet. A leading characteristic of deneholes is the separation of each pit from its neighbor, though they are often so close together that much care must have been exercised to prevent intercommunication. Another is the fact, that, while they are here and there abundant in bare chalk, they are often especially numerous where the top of the chalk is fifty to sixty feet below. Thus at Hangman's Wood, for example, the top of the chalk is fifty-six or fifty-seven feet below the surface, while there is plenty of bare chalk within a mile.

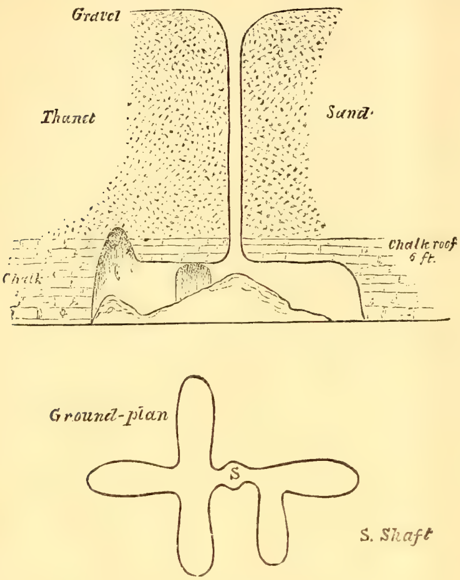


Fig. 2.

Though there are more than fifty separate deneholes in Hangman's Wood, each shaft being at an average distance of about twenty-five yards from its nearest neighbor, only five shafts are now open, the rest having fallen in at various times. In most instances, however, there is nothing to suggest that the chambers below have been materially, if at all, injured, the funnel-shaped hollow at the surface being but little greater than those around the mouths of shafts still open. This closing of the great majority of the shafts is not by any means simply disadvantageous to denehole explorers, though it certainly increases the cost of exploration; for it is obvious that closed pits necessarily afford more satisfactory evidence than such as have been visited from time to time, either from curiosity or to recover a lost sheep or hound.

Preliminary examinations of six of the deneholes in Hangman's Wood were made during the summers of 1882 and 1883. A more thorough investigation is now in progress.

RECENT AFRICAN EXPLORATION.

No news has been received at Zanzibar from Giraud since he was deserted by his caravan. A number of the deserters have been arrested and imprisoned under grave charges, but their trial will be deferred until some definite information of the traveller's fate has been received. The French consul asserts, with reason, that an example must be made if it proves that Giraud has been betrayed: otherwise there can be no safety for future explorers.

The distressing news has been received of the total destruction by fire of the fine establishment of the missionaries du Saint-Esprit at Mrogoro. They were left without food or clothing, and the result of their severe labor for two years was destroyed at one blow. The fire would seem to have been accidental; since the natives about them are friendly, and have modified, at the suggestion of the missionaries, many of their savage customs, especially that of human sacrifices, which a year ago were common. Assistance has been sent to the sufferers.

From the Zambezi, news of the death of Commander Foot has been received. It occurred at Blantyre, where he had been appointed English consul. His wife and two children, unable during the prevalent disorders on the upper Zambezi to reach the coast, have taken refuge at the Protestant mission at the junction of the Ruo and Sheri rivers. The deceased was well known in connection with African exploration, and especially with routes of trade and travel in central Africa.

Mr. Hore of the English missionary society has recently started for Ujiji, with his family, a considerable caravan, and two young missionaries, who will assist him in his work.

Some time since, we referred to the operations of Paul Soleillet in the region of Shoa, and his success in establishing friendly relations with King Menelik. The traveller, who left France about three years ago, has now returned to civilization, and, at a recent séance of the Société de géographie, gave interesting details of his journey, and of the character of the region explored by him in the interests of French commerce. The port of Obok, opposite the English military station of Aden, has been occupied by France since 1856, but has only been raised to the rank of a naval coaling-station during the past year.

Behind Obok rises the irregular surface of the Ethiopian highlands, extending westward to the Nile, and southward to the little-known region which encloses the great lakes of equatorial Africa. At different altitudes on its ridges, which rise from five thousand to eleven thousand feet, one finds a succession of all the climates of the torrid and temperate zones. The olive, cypress, indigo, and coffee plants grow wild there; while cotton, sugar-cane, the vine, and cereals are successfully cultivated. In the same regions where the elephant, buffalo, and rhinoceros flourish in a state of nature, one finds innumerable herds of cattle, sheep, and horses. Soleillet succeeded in opening a caravan route to Kaffa by way of Shoa, which is subject to the usual objections of time and

expense, twenty or thirty days being required to reach the highlands from Obok. However, the only route previously available took forty or fifty days for the same transit. Transportation is very expensive, reaching four or five hundred dollars per ton; so that only the most valuable goods, such as arms and ammunition, can be profitably sent in, and gold, ivory, and musk brought out. However, Shoa has a population of three millions, intelligent and semi-civilized, whose manners and customs approach those of Europe, who are Christians, and are governed by a code of laws derived from the Institutes of Justinian. The construction of a railway of two or three hundred miles in length would open an immense market for the manufactured goods of Europe. Soleillet's labors have been rewarded by the cross of the legion of honor.

INGERSOLL'S COUNTRY COUSINS.

Mr. Ingersoll's 'Short studies in natural history' is a revised reprint of a number of handsomely illustrated articles on a variety of subjects, which have recently appeared in various popular magazines. Of the twenty-one chapters, three are devoted to birds; one each to shrews and seals; three to oysters and their enemies; one each to rattlesnakes, squids and their allies, elk-antlers, the pompano shells, the caverns at Luray and at Pike's Peak, the abalone, shell-money of the American Indians, etc. On many of these subjects the author writes from personal observation; but much of the book, as might be expected, is compiled. In detailing his own observations, he seldom wanders from the mark; but, in treating subjects at second hand, he is occasionally betrayed into misstatements, either through inattention or by his authorities, whom he is not in position to properly weigh. We are surprised, for instance, that he should soberly repeat the assertion that mocking-birds are able to kill large snakes by beating them with their wings. He shows a not very clear conception of his subject, when, in speaking of the shrews, he states that the smallest American species belong to the genus Blarina; nor is this the only glaring inaccuracy in the chapter on these animals. A very excellent account of the large-billed water-thrush (Siurus motacilla) is marred at its close by the statement, 'This is a northern bird,' — the opposite of the truth, when contrasted, as here, with the small-billed species. Equally careless and inexcusable is the statement that martens, as well as weasels and ermines, turn white in winter. The interesting and very sensible article on 'Rattlesnakes in fact and fancy,' however, while not wholly free from errors, treats the subject of 'mimicry' in relation to the rattles with commendable judgment. In the account of star-fishes as enemies of the oyster, there are some overdrawn statements respecting the power of multiplication by division possessed by star-fishes. In the chapter on 'Periwinkles and other oyster-pests,' the large 'winkles,' or 'conchs,' of the genera Sycotypus and Fulgar, are erroneously stated to be unprovided with a lingual ribbon of teeth. The quahaug is said to be usually safe from the ravages of these species; but this is by no means the case, since at some localities we have found the quahaug to be their principal prey, even the largest specimens not escaping their rapacity. It is stated, on the authority of 'an intelligent man,' that Fulgar carica is able to draw even the razor-shell out of its burrow, and devour it; while the fact is that this is done by even very young examples. The chapter on 'Seals and seal-hunting in the North Atlantic' is far from accurate in many of its statements; but, strangest of all, under the page-heading 'A bit of comparative anatomy,' we are told that the tail of the whale, and of cetaceans in general, is not a 'tail' at all, but is structurally homologous — having the same component bones — with the hind-flippers of a seal and the hind-limbs of other mammals. Not to cite other frequent evidences of either carelessness or ignorance, the foregoing will show that a very readable, and in the main commendable, book may contain faults of a very serious character. The author tells us the book is written in the hope that it may "contain not only some entertainment, but also helpful suggestions for those who take delight in outdoor studies." It certainly does contain a very large amount of interesting information very entertainingly told, few writers of popular natural-history books having either the literary ability or the knowledge shown by Mr. Ingersoll in the present series of papers. It is the greater pity that here and there he should be found so grievously tripping.

The book is very carefully and attractively printed, and the illustrations are artistic and fitting; but even here the frontispiece is entitled 'Tree toads,' while only one of the two species figured is a tree-toad, though both are placed *on a tree;* the other being the wood-frog, and as such is correctly referred to in the text. In the explanation of the cut of a shrew's skull (p. 35), 'under side of skull' should be 'upper side of skull.'

Country cousins: short studies in the natural history of the United States. By Ernest Ingersoll. New York, *Harper & brothers,* 1884. 252 p., illustr. 8°.

THE FORESTS OF THE UNITED STATES.

Many essays and some books there are to tell us what should be done with our forests, or with their remains. This ninth volume of the reports of the census taken in 1880, now before us, tells us what these forests are. First and briefly as to their general distribution in accordance with the climate and configuration of the country. There is, in the most general terms, a forest of the Atlantic, and another of the Pacific region, widely separated through a long stretch of the continent, more approximate at their northern extremities, and essentially but loosely joined along the Mexican borders from Texas to southern California by a very peculiar arboreal vegetation. And even where the Atlantic and Pacific woods are most widely severed, as in about latitude 40°, the western own to a near relationship with the eastern along the line where the Rocky Mountains flank the plains. Together, the two compose one large whole, — a temperate North-American sylva, the harmony of which is not greatly disturbed by the intrusion of Mexican types into its southern borders. A more seriously discordant element, however insignificant geographically, but figuring rather prominently in the catalogue, comes as a consequence of the southward extension of the peninsula of Florida, upon which a good number of tropical West-Indian trees have effected a lodgment. Like other immigrants, these denizens must be received upon the same footing with those more truly to the manner born, although they sensibly impair the homogeneity of the United States sylva.

Next as to the genera and species of which our forests are composed, amounting, it appears, to a hundred and fifty-eight genera and four hundred and twelve species. A considerable number of these, however, are only arborescent at their best, never attaining the magnitude of timber-trees; and forty-eight of the genera, and nearly sixty species, occur only in semi-tropical Florida. The systematic account of the trees fills two hundred and twenty pages of the volume. It is wonderfully full, not to say exhaustive, in the bibliography and synonymy, is comprehensive as to geographical ranges, particular in its statement of the character of the wood (the specific gravity and the amount of ashes being specified under each species), and also its economical uses. But descriptive matters and all botanical details, beyond a mention of the height attained by the tree, are scrupulously omitted. Even the nature and appearance of the bark, characteristic as it generally is, and sometimes very important in its practical applications, is nowhere mentioned, except in a single line in a single case, that of the canoe birch. Even the difference between the cherry birch and the yellow birch, so striking in the bark and so slight in every other respect, is not alluded to. This is evidently done on principle. It was necessary to draw the line somewhere, and Professor Sargent has drawn it very taught. We should grieve inconsolably over the exclusion, except for our expectation that the author means to make amends in another work, in which the tree will stand for more than its timber. Let us note, in passing, that in any future publication 'Palmaceae' should give place to 'Palmae.' It was a good thought to supply a separate and full index to the 'Catalogue of forest-trees,' as this part of the volume is modestly entitled. The addition of as much descriptive botanical matter as there is of bibliography would have made of it a compendious treatise.

We will not complain that practical matters predominate in a census report. Part ii., 'The woods of the United States,' fills two hundred and forty pages, most of it tabular matter. 'Woods' are here used in the sense of timbers; and this portion of the volume records with much completeness the result of an exhaustive determination of the specific gravity, the amount of ash, the weight per cubic foot, the tensile strength, the behavior under compression, and the fuel value of the wood of all the species. This great piece of work was done by, or under the direction of, Mr. S. P. Sharples. The wood specimens are preserved in two full series, — one in the National museum at Washington, one in that of the arboretum of Harvard university; and the surplus material, worked into 12,961 museum specimens, has been made into sixty sets, and distributed to nearly as many educational institutions.

Any one wishing to know the relative specific gravity of the wood of our trees has only to consult the table beginning on p. 249. He will learn that all those which are heavier than water are of semi-tropical species, or of the arid south-western interior region; that the Floridian Condalia ferrea leads the list (specific gravity, 1.3020); that Cercocarpus ledifolius, the mountain mahogany of Utah, etc., comes up to 1.0731; that the lightest conifer-

Report on the forests of North America (exclusive of Mexico). By Charles S. Sargent, Arnold professor of arboriculture in Harvard college, special agent tenth census. Washington, *Government*, 1884. 612 p., 4°; 39 colored maps, 4° and f°; with portfolio of 16 maps, eleph. f°.

ous wood is of the big tree, Sequoia gigantea (0.2882); and that the lightest wood of all is of a fig in Florida, Ficus aurea (0.2616).

Upon part iii., 'The forests of the United States in their economic aspects,' which concludes the volume, and which the fine colored maps graphically illustrate, Professor Sargent has bestowed great pains, and to much purpose. The statistics of the lumber industry for the census year, the table of forest-fires during that year, the map showing the proportion of woodland within the settled area burned over in that year, and the map showing the character of the fuel used in different parts of the settled portion of the country, are most interesting and instructive. Not less so are the detailed and fully illustrated summaries of the present condition and character of the woodlands of every state and territory.

The principles of forest preservation, the needs of the country in this respect, and its importance in certain districts, also the special need, as well as great difficulty, of guarding against forest-fires, are touched upon as occasion serves. If the country suffers hereafter, it will not be from the lack of good advice. Possibly the forest report for the eleventh census may show that it has not all been wasted. If the forest agent for 1890 brings out a more valuable report than that of 1880, it will in a measure be due to the advantages furnished by the work of his predecessor.

SCHELLEN'S DYNAMO-ELECTRIC MACHINES.

This is a translation from the third German edition, with large additions and notes relating to American machines by Mr. Keith. In the first two editions of the original the work appeared in one volume; but in the third the author thought it desirable to divide it into two, and in this the translators have followed him. The first volume only is now published, and is principally devoted to methods and machines for producing electric currents.

It is not easy to keep pace with the production of dynamo-electric literature at present, and one cannot avoid the conclusion that much of it might be suppressed without really serious loss. Books on dynamo-electric machinery may be prepared for the general intelligent public, for the so-called 'practical' electrician, or for the student of electrical engineering. Dr. Schellen's book is not likely to satisfy the demands of either of these classes.

About a hundred pages bear the general title of 'Preliminary physics.' Forty of these are occupied by the development of the fundamental idea of the production of electricity by induction, which is accomplished in a manner not differing greatly from that of other similar treatises. The remainder contains the consideration of methods of electric measurements and measuring instruments. Including as it does dynamometric, photometric, and electric measurement proper, this comes near being the most unsatisfactory portion of the book. The great importance of thoroughly understanding this part of the subject is strongly emphasized; but the reader will seek in vain for its satisfactory elucidation. The study of dynamometers is by far the best of this part; and the translators have shown wisdom in inserting full descriptions of the Kent dynamometer prepared by Dr. Henry Morton, and of the Brackett dynamometer prepared by Professor Brackett, its inventor. Under electric measurement little is to be found, aside from the description of a few of the coarser devices for determining electromotive force and current strength, and there is really nothing concerning methods of measurement. Although the book is of very recent date, the units of measure are not defined in accordance with the agreement of the international electrical congress; and, in the discussion of photometric standards, no mention whatever is made of that adopted by that body. 'Intensity' for current, or current strength, and 'tension' for electromotive force, are found, unfortunately, throughout the work.

The bulk of the volume is devoted to descriptions of magneto and dynamo electric machines in great variety. These are generally given in considerable detail, accompanied by diagrams and plates. Many of the descriptions are very satisfactory, although most of them have appeared already in similar publications.

The concluding chapter contains a brief discussion of the theory of dynamo-electric machines, and a classification of dynamos. The discussion of the theory would be greatly improved by expansion, and the classification of dynamos would be more useful to the reader if introduced before the description of machines. An appendix contains a number of tables of considerable practical value, and an attempt to define the 'absolute, or C. G. S. system of units of measure.' In a previous chapter the necessity of being thoroughly fa-

Magneto and dynamo electric machines. By Dr. H. Schellen. Vol. i. Translated from the third German edition by N. S. Keith and Percy Neymann. New York, *Van Nostrand*, 1884. 518 p. 8°.

miliar with these units is affirmed; but in these two pages a clear understanding of them is made well-nigh impossible. A single illustration will serve to show the character of many of these definitions.

"*The unit of tension* is that tension (potential difference) between two points which requires the expenditure of one unit of force (1 dyne) to move 1 coulomb from one point to the other by overcoming the electrical repulsion $\left(\text{Dim. } C^{\frac{3}{2}}G^{\frac{1}{2}}S^{-2}\right)$.

"*Technical unit*, 1 volt = 10^8 (C. G. S.) units."

BARNARD'S PYRAMID OF GIZEH.

DR. BARNARD tells us that Mr. Flinders Petrie, after having published a book in 1874 to give 'irrefragable proof' of the supernatural metrology of the Great pyramid, in 1880 printed another in which he recants all that doctrine. This surprising instance teaches us that it is possible for a man to hold the views of John Taylor and Piazzi Smyth, and yet be capable of using his mind sanely upon the subject. But Mr. Petrie had shown himself by his 'Inductive metrology' to be an adept in the logic of induction; and surely one would expect the study of logic, if it be of any use at all, to save a man from such follies as this metrological theory of the pyramid.

The main fallacy of the advocates of it is one which has been pointed out in C. S. Peirce's 'Theory of probable inference' as a violation of the inductive rule that the characters for which a lot is sampled ought to be predesignate; that is, settled upon before the examination of the sample. Given a collection of numerical data, it is always possible, by twisting them about, to find some recondite and curious relationship between them; for the possibilities of such relationships are endless. Mr. Pliny Earle Chase has convinced the world of that, if of nothing else.

Another thing which the pyramid-bitten seem to overlook, is that an hypothesis antecedently likely does not mean one which they are antecedently inclined to like, but one which belongs to a class of explanations among which the balance of positive evidence tends to show that the true theory is to be looked for.

Dr. Barnard treats the subject with a great deal of pertinent wit; he has drawn from the stores of his learning for interesting information on every page; and, what is best, he has estimated the strength of each argument with unerring good sense. Perhaps he is a little too indulgent to the idea that the vertical height of the pyramid was intended to bear the same ratio to the perimeter of the base that the radius of a circle bears to its diameter. Fourteen centuries after the building of the Great pyramid under King Apophis of the seventeenth dynasty (Joseph's Pharaoh, as it is said), was written the mathematical treatise of Ahmes, which has been preserved to us. This work virtually assumes

$$\pi = (\tfrac{4}{3})^4 = 3.16,$$

and there is no good reason for supposing that the pyramid-builder knew better. On the contrary, Sir Henry James's idea is probably correct, that the rule for the slope was, that at the corners the rise should be nine on a base of ten.

The supposition that the inclination of the entrance-passage was connected with a pole-star, derives, it would appear, its chief strength from its forming a part of Mr. Procter's ingenious theory of the orientation of the pyramid, which certainly has much to recommend it; yet the accuracy of orientation may be merely accidental, like that of the District of Columbia.

The imaginary metrological system of the Great pyramid of Gizeh. By F. A. P. BARNARD. New York, *Wiley*, 1884. 5+106 p. 8°.

NOTES AND NEWS.

MR. H. H. WARNER of Rochester, N.Y., offers two prizes for the year 1885. First, two hundred dollars for each and every discovery of a new comet made from Feb. 1, 1885, to Feb. 1, 1886, subject to the following conditions: 1. It must be discovered in the United States, Canada, Mexico, West Indies, South America, Great Britain, or the Australian continent and islands, either by the naked eye or telescope, and it must be unexpected, except as to the comet of 1815, which is expected to re-appear this year or next; 2. The discoverer must send a prepaid telegram immediately to Dr. Lewis Swift, director, Warner observatory, Rochester, N.Y., giving the time of the discovery, the position and direction of motion, with sufficient exactness, if possible, to enable at least one other observer to find it; 3. This intelligence must *not be communicated to any other party or parties*, either by letter, telegraph, or otherwise, until such time as a telegraphic acknowledgment has been received by the discoverer from Dr. Swift (great care should be observed regarding this condition, as it is essential to the proper transmission of the discovery, with the name of the discoverer, to the various parts of the world, which will be immediately made by Dr. Swift). Discoverers in Great Britain, the Australian continent and islands, West Indies, and South America, are absolved from the restriction in conditions 2 and 3. Second, a prize of two hundred dollars in gold to

any person in the world who will write the best three-thousand-word paper on the cause of the atmospheric effects ('red light,' etc.) accompanying sunset and sunrise during the past sixteen months. It is desired that these papers be as original as possible in facts, observations, and treatment.

— Under the auspices of the Academy of natural sciences of Philadelphia, Prof. D. G. Brinton began on Jan. 26 to deliver a series of ten lectures on American ethnology and archeology. He will be followed by Professor Benjamin Sharp in a course of from twenty to twenty-five lectures on the principles of zoölogy; Professor Angelo Heilprin, a course of practical instruction in geology and paleontology, to be supplemented by field-excursions, and a final excursion to the region of the upper Delaware or the valley of Virginia, extending over a period of ten days or more; and Prof. H. Carvill Lewis, a course of twenty-five lectures on mineralogy and lithology, with practical demonstrations in the laboratory.

— The American philosophical society has just published an index to its Proceedings and Transactions down to 1883, prepared by Mr. Henry Phillips, jun., one of the secretaries. It will be found very useful, but would have been much more so had it been made in a single index, instead of in three, as at present. The simple prefix of P and T would have distinguished the Proceedings and the Transactions as readily as the present Roman numerals do the volumes; and a *T* could similarly have been made to indicate the old in distinction from the new series of the Transactions.

— The first number of the *Journal of mycology*, announced in a recent issue, has been received, and can hardly be said to promise much for the future of mycology in this country. It is almost wholly devoted to descriptions of new species; for the abstract of Wharton's paper on Fries's nomenclature of colors, taken from *Grevillea*, is of slight botanical value. If this number is an index of what is to come, it will be a matter of regret that the journal was ever started. The proper place for the description of species is in the proceedings of scientific societies, or in the reports issued by the different states or by the national government. In the case of a monthly journal, the necessity of filling the requisite number of pages must quickly result in the production of hastily or carelessly prepared descriptions, which will only be an encumbrance: the inevitable tendency will be to degenerate into a mere species-mill. Neither mycology nor any other natural-history science can hope for advancement through journals having no higher aim than this. And what shall we say to authors who describe one of their 'species,' and then add the following note: "It is quite probable that these are only the spores of some other fungus accidentally scattered on the leaves, and it is given here more especially to call attention to it, in order to ascertain its true character"?

— In the *Atlantic monthly* for February, Mr. Bradford Torrey has a pleasantly written paper on winter birds about Boston, in which he treats briefly the various species that enliven our fields and waysides at this inclement season. The writer shows himself to be a keen discriminating observer, as well as an affectionately appreciative one, and has also a happy way of telling what he has seen. His paper will prove of interest to the ornithologist as well as the general reader.

— Mr. W. W. Valentine of Richmond, Va., in the specimen pages of his 'Comparative study of the new high German language, theoretical and practical,' evidently gives a translation of the notes of some lectures on German grammar which he once heard in Germany. Like most lecture-notes, they contain some mistakes, and are, except for a reader already familiar with the subject, obscure through their conciseness. And if there has been in this book any winnowing, any selection at all of topics to be treated, the winnowing has certainly left much chaff among the wheat. It is difficult to conceive of any class of students in America who could, with advantage, study German in such a grammar. We subjoin a few characteristic extracts: "Consonants accumulate in simple words and compounds. It occurs often from the syncopation . . . In compounds they accumulate very often. — In English sex determines class-distinction for the most part. — The *es* of the neut. nom. acc. (also voc.) is often omitted in folk-speech, and also in poetry where it stands in connection with euphony and quantity. — Relics of gender are found with the demonstrative *das* that. — *Essen* (better *eszen*). [!!] — Reduplication occurred originally with the preterit stem of all stem verbs.—*falten* to fold (redupl.) Only the past participle is preserved in literary language." [!!].

— The fourth number of the *Anuario bibliográfico de la República argentina*, by A. N. Viola (Buenos Aires, 1883), contains a good account of the publications issued in that country for 1882. It comprises political and social subjects, as well as scientific and technical, and aims to include every thing bearing an Argentine imprint. Scientific subjects are allowed thirty pages, which are filled chiefly with mention of the work accomplished by several government institutions, such as the universities and the Cordoba observatory, and by the scientific societies of Buenos Aires and Cordoba. The entire list fills six hundred pages, small octavo. Another local list that deserves mention is Trautwein's *Bibliographie der alpinen literatur* for 1883, that has appeared for the last fourteen years in the *Zeitschrift des deutschen und oesterr. alpen-vereins.* It contains about four hundred titles; but journals are entered only by their name, not by their contents. There are no abstracts, and the arrangement is only by name of author; so that convenience of use would require more care expended in its preparation.

— Mr. A. M. Elliott, in the Johns Hopkins circular for December, writes of a philological expedition to Canada: —

"In point of language, the Canadian French is certainly one of the most interesting topics for a philologian. Here we find that time has stood still, especially for the more remote rural districts; and the scholar could easily imagine himself holding

intercourse with the subjects of Louis XIV. This means that we have the unique privilege, in this age of steam and travel, of studying in them a form of speech that has scarcely known change for the past two centuries. But this idiom is not a dialect of that remote period; and the greatest surprise to a student of language arriving in Canada is to find, that, contrary to the general impression of scholars, the vernacular does not bear any specific dialectic character, but is the middle (sixteenth century) French, with those natural changes which would be produced by the intimate fusion into a whole of all the different species of language that were originally brought from the mother-country. An influence upon the language must be noted in the original seigniorial tenure which prevailed throughout Lower Canada. The seigneurs were the second sons of noble families who chose the better class of peasants to accompany them to their homes in the new world; and here each ruler laid out on the river his little kingdom (generally $\frac{1}{2} \times 3$ leagues in dimensions), which he divided among his colonists in concessions of 3×30 arpents. This arrangement produced a series of centres of civilization in which the lord and his educated friends were brought into more or less intimate contact with the common people: in truth, we have abundant evidence to show that the relation of the seigneur to his people was much more intimate in these early settlements of Canada than in the mother-country. After the conquest (1760), nearly all the nobles fled the country, and the different classes of society were more thoroughly mixed than they had ever been before. The influence of long and constant contact with a Teutonic race has had the effect to temper the rash impulses of the Gaul; and this is in no respect more marked than in his speech, where a quiet monotony largely prevails, and strikes the stranger immediately as one of its leading characteristics. It has not the rhythm, the inexhaustible variety, and rich cadence of the Gallic tongue as it is spoken to-day in France."

Mr. Elliott also records the apparent vigor of the old French stock, and their wonderful absorbing-power, as shown by the curious phenomenon of a people in certain sections having the racial characteristics of the English or Scotch, and bearing the names of Warren, Frazer, and McDonald, and yet unable to speak a word of the mother-tongue. The English names of roads and villages show who the occupants of such places were a few years ago.

— A circular from the U. S. signal-office informs us, that, in accordance with the general assent of co-operating weather bureaus, the observations at our signal-service stations, as well as those of the widely extended international system, are now taken eight minutes and twelve seconds earlier than formerly, the change having been made on Jan. 1. The new time of the morning observation, which corresponds to the daily international observation, is therefore seven A.M. of our eastern standard, corresponding to Greenwich mean noon; and this has the great advantage of being recorded with the same name for the day of the week the world over.

— It was stated last spring that quantities of floating pumice, supposed to be derived from Krakatoa during the recent eruption, reached the island of Réunion, at the harbor of St. Paul, on the 22d of March, 1884, having thus made a voyage of some two hundred and six days at a rate of six-tenths of a mile an hour. It now appears that an immense quantity of pumice of similar appearance, and supposed to be from the same source, reached Tamatave, Madagascar, in the first week of September, 1884. Specimens have been sent to the Société de géographie, and will be reported upon by the director of the School of mines.

— Capt. Lundin of the bark Vega, at Philadelphia, reports that at three A.M., Dec. 22, in latitude 40° 31′ north, longitude 16° 10′ west, he felt several slight shocks of an earthquake. It was calm at the time.

— The distribution of time on a commercial basis is claiming the attention of inventors and capitalists. Besides the Standard time company of New Haven (which has been idle the past year, owing to an arrangement with the Time telegraph company of New York, which has now been terminated by the former company), there are the Standard time company of New York, now organizing, to distribute time on the Mayerhofer system of compressed-air impulses, synchronizing and winding secondary clocks; the National time-regulating company of Boston, which proposes to give audible signals over telephone-lines, which can be heard after the manner of repeating watches by placing the telephone to the ear; a company with headquarters at Pittsburg, which is to use the system devised by Mr. Gardner for long or short distance telegraph time-signalling and clock-synchronizing; the Time telegraph company of New York, which has shown its best development in the electric dial system in Providence; the Wenzel pneumatic system of clocks, actuated by compressed air acting through the medium of glass air-holders lifted out of a glycerine bath at each impulse; and we suppose that we shall soon have companies organized on the Popp-Resch-Mayerhofer system, now used in Paris, and the Mautner system of Vienna. Apropos of the subject, A. Merling has published an excellent little book on electrical clocks, entitled 'Die electrische uhren; Electrotechnische bibliothek, band ii. (Braunschweig, *Friedrich Vieweg und sohn*, 1884, 323 p., 12°); and M. A. Favarger continues his articles through the current year of the *Journal Suisse d'horlogerie* (Geneva), on 'L'électricité et ses applications à la chronométrie.'

— Dr. Hugo Gyldén, whose call to the professorship of astronomy in the university of Göttingen, made vacant by the death of Dr. Klinkerfues, we noted some time ago, has, in consequence of a liberal offer from the king of Sweden, decided to remain at his present post as astronomer royal, and director of the observatory at Stockholm. Dr. Gyldén is one of the editors of the new journal entitled *Act amathematica.*

— Dr. Th. Brédichin has resigned his position as director of the observatory at Moscow, Russia.

— The Roumanian government has voted the funds necessary for the establishment and maintenance of the Central meteorological observatory in Bucharest, and Mr. Hepites has been appointed the director.

— In November, 1884, Mr. Maxwell Hall, director of the Kempshot observatory, Jamaica, attacked again the question of the variability of the light of Neptune as bearing on the planet's rotation on its axis. He finds that fifteen rotation periods occupy 118.71 hours; so that each period is 7.914 hours, — a result which he considers identical with the period derived from his observations in 1883.

— The Lena polar expedition, commanded by Lieut. N. D. Jurgens, who arrived at St. Petersburg on Jan. 4, has proved a success. No one died or was seriously ill; scurvy, which appeared the first winter, being quickly suppressed. The second winter was somewhat milder than the first, although the spring and autumn were cooler. In western Siberia, in the *taiga* (forest) north of Jenisseisk, there was rain, and the rivers were open, as late as the 1st of December. The lowest temperature experienced by Lieut. Jurgens was — 50° C.; but the chief inconvenience was the frequent storms, although observations were not interfered with. Those of the first year have already been calculated by Mr. Eigner, who arrived in St. Petersburg in advance. The summer was almost without sun; and 12° C., the highest temperature recorded, was reached only once. This had a decided effect on the vegetation. Mosses were almost the only plant observed, and willows grow to a height of a few inches only, though inland, where the sea wind does not penetrate, they reach two feet. Magnetic disturbances were less frequent and important the second year than the first; thus proving the wisdom of the scientific men, who insisted that the observations should be made in 1882–83. The survey of the delta considerably changes our ideas about this region. Among other things, Sagastyr, where the observations were made, is not the most northern point of the delta; but this honor belongs to the Island Dunas, 74° north. The changes of water-level at Sagastyr are inconsiderable; the expanse of water being too large for high river-floods, and the tides small and irregular, largely influenced by the winds. Lieut. Jurgens left Sagastyr on July 8, passed several days at Yakootsk, whence he reached Kireusk by steamer in twenty-four days, and continued by boat on the Lena for two hundred versts; he was then obliged to travel by land, as ice was fast forming on the river. The journey to Irkutsk was made difficult by the lack of snow, which was also largely the case between Irkutsk and Neuberg, where he took the railroad. A telegram has just been received from Dr. Bunge, the naturalist of the expedition, who has not returned, stating that he is on the way to Irkutsk, where he will winter, and whence he will start early in the spring for the basin of the Jana, north-eastern Siberia, which he will explore in 1885, and in the spring of 1886 he will start for the New Siberia Islands.

— The publications of the second geological survey of Pennsylvania make steady progress. Reports on Cameron, Elk, Forest, Perry, Huntington, and Delaware counties, are in press. Reports on Lebanon, Dauphin, Cumberland, and Franklin counties, are partly prepared for the press, together with the remaining sheets of the South Mountain survey, one additional atlas and the second report of the progress of the anthracite survey, the second part of the report on the Monongahela collieries, and the second part of the report on Perry and Juniata counties. The state geologist has prepared a hand-atlas of the state, reducing the county maps in common use to a uniform scale of six miles to an inch, and coloring them geologically, according to the reports of progress in their respective districts, made to him by the assistant geologists of the survey. This atlas is just about to issue from the press. The board of commissioners has just recommended an appropriation of ninety thousand dollars for the next two years; twenty-five thousand dollars to be expended annually to continue the anthracite survey; ten thousand dollars annually to continue the topographical survey and commence the construction of a state map; and ten thousand dollars annually to extend the oil-region survey, to continue the chemical analyses of minerals, to provide for economic geological examinations in the bituminous and iron-ore regions, and to continue the work of the state geologist.

— At the annual meeting in February, according to *Nature*, the Royal astronomical society will award its gold medal to Dr. W. Huggins for his researches on the motions of stars in the line of sight, and on the photographic spectra of stars and comets. This is the second time that Dr. Huggins has received the medal, he, in conjunction with the late Professor Miller, having received it in 1867, for his researches in astronomical physics.

— At a meeting of the French academy of sciences on Jan. 5, Mr. Pasteur presented a paper, in the name of Mr. Duclaux, on the germination of plants in soil free from microbes. Mr. Duclaux had undertaken experiments in order to determine the effect of the presence of microbes upon germination. In his experiments he used pease and Holland beans, the cotyledons of which uniformly appear, one below the soil, the other above. The soil had been previously sterilized by processes of which the author gave no details, and, in addition, had been moistened with milk also sterilized. Under these conditions, germination did not take place, and at the end of two months the milk showed no indication of alteration. These two experiments tend to prove that the presence of microbes in the soil is necessary to the development and to the life of plants. Pasteur added some critical reflections. He mentioned that he had before this proposed to his pupils to examine what would happen to an animal subjected from birth to nourishment the elements of which had previously been freed of microbes, and consequently reduced to its nutritive principles, pure and simple. To this he had been led by the idea that in such conditions the maintenance of life and development would be impossible with animals. This conclusion leads to the

very important knowledge that the presence of microbes in foods is indispensable to digestion; that is to say, of actions necessary to the elaboration of matters destined to serve for the nutrition of the animal body. The total absence of microbes renders the accomplishment of these actions impossible. We can recognize the importance of an exact determination of the part played by microbes in digestion; for this knowledge would lead to interesting views, and perhaps to practical results, regarding the mechanism and treatment of different forms of dyspepsia.

— The enterprising scientific publisher, Doin, of Paris, sends out with the first number of *Revue scientifique* for this year the first number of a new journal, called *Journal des sociétés scientifiques*, which is to appear weekly, and to contain a brief report of the meetings of the principal scientific societies of the great cities of Europe. The plan of the journal is an excellent one, and one which should secure it an ample subscription list. It costs only fifteen francs, postage paid, to any part of the universal postal union. The first number contains reports of the French academy of sciences, the academy of medicine, and the geographical, anthropological, and biological societies of Paris, the societies of public medicine and of surgery, as well as of the academy of medicine of Belgium and Vienna, and the clinical society of London. It forms a quarto of ten pages.

— Among recent deaths we note the following: Benjamin Silliman, at New Haven, Jan. 14, at the age of sixty-nine; John Birmingham, astronomer, at Millbrook, Tuam (Ireland), Sept. 7, at the age of sixty-eight; Antoine Quet, physicist, at Paris, Nov. 29, at the age of seventy-four; Dr. E. V. Ekstrand, botanist, at Upsala, Nov. 10; A. Keferstein, lepidopterologist, at Erfurt, Nov. 28; Dr. Wilhelm Rüppell, the first scientific explorer of Nubia and Abyssinia, at Frankfort-on-Main, Dec. 11, at the age of ninety; Auguste Chevrolat, one of the founders of the French entomological society, at Paris, Dec. 16, at the age of eighty-five.

— With the completion of volume x. (for 1882), Dr. L. Just will resign the editorship of the *Botanisches jahresbericht*, which will then be privately conducted by Dr. E. Koehne of Berlin, and Dr. T. Geyler of Frankfort-on-Main.

— By the will of Mr. George Bentham, who died in September last, the Linnean society of London, and the Royal society scientific relief fund, will receive, *Nature* states, a thousand pounds each. The residue of his real and personal estate is to be held upon trust, to apply the same in preparing and publishing botanical works, or in the purchase of books or specimens for the botanical establishment at Kew, or in such other manner as his trustees, of whom Sir Joseph Hooker is one, may consider best for the promotion of botanical science.

— A "Report on the Egyptian provinces of the Sudan, Red Sea, and Equator, compiled in the intelligence branch quartermaster-general's department, horse-guards," has just been published by the war-office at London for three shillings and sixpence, and will be found of great service to those following the current events in upper Egypt, especially as it contains a capital map, and descriptions of all the routes of travel in the Egyptian Sudan known in July last.

— The capuchin, Father Massaga, who has spent thirty-five years as missionary in the African desert, has been commanded by the pope to write his memoirs, that they may be published by the curia. The memoirs will be in ten volumes, and will be illustrated by a Viennese artist.

— We learn from *Nature* that the German government has granted another sum of £7,500 for the scientific investigation of Central Africa, and £1,900 for the working-out of the materials collected by German polar expeditions.

— James Jackson, secretary of the French geographical society, has issued a new edition of his list of velocities. The first velocity given is that of the Mer de Glace, — according to Tyndall, .0000099 of a metre per second. The last, 463,500,000 metres per second, is that of the electricity in a wire connecting the inside and outside of a Leyden jar. What is meant by the latter velocity is not quite clear, when we consider that we can no more speak of the velocity of the conduction of electricity than we can of the velocity of the conduction of heat.

— Dr. Zulinski has published in a Warsaw medical journal the results of a long series of experiments made by him, both upon human beings and animals, with a view of verifying the physiological effects of tobacco-smoke. He found, in the first place, that it is a distinct poison, even in small doses. Upon men its action is very slight when not inhaled in large quantities; but it would soon become powerful if the smoker got into the habit of 'swallowing the smoke:' and Dr. Zulinski ascertained that this toxical property is not due exclusively to the nicotine, but that tobacco-smoke, even when disengaged of the nicotine, contains a second toxical principle called colidine, and also oxide of carbon and hydrocyanic acid. The effects produced by tobacco depend, he says, to a great extent upon the nature of the tobacco and the way in which it is smoked. The cigar-smoker absorbs more poison than the cigarette-smoker, and the latter, in turn, than those who smoke pipes; while the smoker who takes the precaution of using a nargile, or any other apparatus which conducts the smoke through water, reduces the deleterious effects of tobacco to a minimum. Dr. Zulinski considers the artificially lightened tobaccos to be more dangerous than the darker-colored ones.

— The article on economy of fuel, on p. 74 of this volume, contains an error to which a correspondent calls attention. It should have stated that the Oregon consumes 337 tons of coal per day, which gives combustion at the rate of over 1,500 pounds of coal for each mile traversed.

SCIENCE.

FRIDAY, FEBRUARY 13, 1885.

COMMENT AND CRITICISM.

The committee on the government surveys having at this writing not yet made its report to congress, it may be worth while to consider a recommendation which touches upon the subject, made by the secretary of the navy in his last report, repeated indeed from former reports of the same official. It is to the effect that the work of the revenue marine, the lighthouse board, and the coast survey, so far as the latter is concerned with marine investigations, should be brought, with that of the hydrographic office, under the direction of the navy department, "whereby greater unity of purpose and consistency of action would be secured."

It can hardly be questioned that the change thus proposed might be economical in preventing the duplication of outfits, and that it might open much practical and profitable work to naval officers; but, apart from the better general scheme of the national academy, there is, perhaps, an element of difficulty in this plan, that might be used against it. The execution of certain technical parts of hydrographic work requires special skill; and, if the demand for this skill were supplied only by those who have made the navy their life-career, it might not be so well satisfied as if supplied from a larger circle. Moreover, the experience needed for the best performance of certain duties can be gained only by years of perseverance; and, when gained, the country cannot afford to lose it by its possessor being ordered off on a long cruise, as is at present the fashion in naval routine.

It may be seen that these disadvantages do not appear in the present organization of either the geological survey or the coast survey, for their recruits are drawn from all sources. They are not first asked, if, above every thing else, they are naval or military men, but rather if they are geologists or topographers; and, further, whoever gains successful experience in these services, gains also a relatively permanent occupation in his specialty. Perhaps it is in part for these reasons that the committee of the national academy did not include in its recommendations the suggestions found in the report of the secretary of the navy.

But all things considered, there seems to be sound reason in the policy of the secretary, "that the officers and seamen of the navy should be employed to perform all the work of the national government upon, or in direct connection with, the ocean." An arrangement by which the geodetic and geological surveys occupy themselves with our land possessions, while a bureau in the navy department determines what we need to know of the ocean and its shores, does not seem irrational. It would involve, of course, certain changes in the departments in the direction indicated by the possible element of difficulty above named. It is absolutely essential to the success of such a policy, that the scientific naval bureau which it requires, should not be, except in its subordinate offices, a training-school for naval officers. Its work must be directed, and for the greater part carried on, by men permanently employed for their special tasks, as is the case in the coast and geological surveys. Without this, there would be little gain of economy or uniformity, and matters would far better rest as they now are. If the change were made, there would be much outcry in certain quarters, and perhaps, for a time, some injustice hardly separable from so considerable a revolution; but these difficulties would be only of a personal and temporary nature, and not inherent in the case. Once accomplished, we should look back with wonder on the present strange order

of things in which our navy is intrusted with the exploration of the deeper seas and the mapping of far distant coasts, while it is held unfit to survey the shallower waters of our own shores.

THERE IS probably no other subject in which practice lags so far behind knowledge as it does in the teaching of small children, and especially in country schools. The latest appliances in electrical apparatus are no sooner invented and tested, than they are brought into use, and supersede what were good appliances yesterday; but the antiquated way of teaching arithmetic and reading is still almost universal, in spite of its having been proved again and again that they can be taught by a scientific method in half the time. It was a witty Spaniard who said that the reason English-speaking people are so illogical, is that they have to learn to spell when they are young. The wonder daily grows that their instruction in arithmetic does not wholly destroy what residue of reason their spelling has left behind. A marked and much-needed change was brought about in England by the Association for the improvement of bread-making; and there is no doubt, that, by a vigorous associated effort, — by holding public meetings, by distributing pamphlets, and by all the usual means of agitation, — something might be done to awaken school-committee men and superintendents to some sense of responsibility. There is no better field for the missionary energy of those persons whose first interest is in the maimed and tortured of their own country.

Meantime the Society to encourage study at home could do no better work than to offer a course in pedagogics to primary-school teachers. The teachers of country schools are often intelligent, and eager to learn; but it would be asking too much to expect each one to discover for herself methods of teaching that have only been perfected by many generations of experience. To put them in the way of reading a few inspiring books on the subject would often be to work a transformation in them. This suggestion is made by the circular of information in regard to rural schools, recently sent out by the Bureau of education. That circular itself, if it were widely distributed, would do a great deal of good by means of the model lessons in arithmetic which it reprints from the report of the Massachusetts board of education. They must be in the nature of a revelation to most untrained teachers. It is a pity that the compiler of the circular could not find an equally good and explicit description of the modern art of teaching how to read.

LETTERS TO THE EDITOR.

The relation of form to time of maturity in esculent roots.

MANY facts seem to indicate that a direct relation exists between the form of esculent roots and their time of maturity in the different varieties of the same species.

In the spring of 1883 a few typical roots of the 'long hollow crown' and 'Carter's new Maltese' parsnip were set out for seed in the garden of the New-York agricultural experiment-station, with other roots selected from each of these varieties, which were short and thick, approaching to napiform. As the flower-stalks developed, those from the short, thick roots in both of the varieties were considerably earlier in blooming than the longer typical roots. This unexpected event recalled the fact that the 'round' or 'turnip-rooted' parsnip is earlier in developing its root than the long varieties; also that in the 'Egyptian' and 'eclipse' beets, the earliest two varieties, and the 'French forcing' carrot, the earliest of its kind, the roots are shorter in proportion to their length than in other varieties.

Printed descriptions [1] from the most careful writers upon vegetables indicate that a similar relation exists in the onion and turnip. Thus in the onion the axial diameter in nineteen so-called varieties is noted as less than the transverse diameter. Of these, five are called 'very early,' five are called 'early,' seven 'half early,' one 'rather early,' and one 'rather late.' In seven so-called varieties, in which the axial diameter equals or exceeds the transverse diameter, five are called 'late,' one 'not early,' and one 'early.'

In addition to these, in which the dimensions are given in figures, the 'brown Teneriffe' is described as being 'very flat,' and, with one exception, is called 'earliest of all.' The 'intermediate red Wethersfield' is described as flattened, and the 'two bladed' as 'flat.' Both of these are called 'early.' The 'early white silver-skinned' onion is described as 'about the same diameter as the Nocera, but thicker' (through the axis), and is said to be 'a little less early than the Nocera.' The 'white Portugal' is noted as "a little less flat than the Nocera or 'early

[1] The descriptions examined are from Burr's Field and garden vegetables of America, and from Les plantes potagères of Vilmorin, Andrieux, et Cie.

white silver-skinned;' it is also a little less early." It may be noted, further, that the Messrs. Landreth of Philadelphia declare their 'extra early Bloomsdale pearl,' which is remarkably flattened in form to be the earliest of all onions.

In twenty so-called varieties of the turnip, the axial diameter is noted as less than, or equal to, the transverse diameter. Of these, one is called 'very early,' nine are called 'early,' one is called 'rather early,' and five are called 'half early.' In fourteen varieties the axial distance is noted as greater than the transverse diameter. Of these, one is called 'late,' one 'a little late,' one 'medium,' five are called 'half early,' three 'rather early,' and three 'early.' The 'rouge plat de mai de Munich,' described as being 'very much flattened,' is said to be 'unquestionably the earliest of turnips.' The 'rouge de Milan,' called 'very flat,' is pronounced 'one of the earliest.' In the majority of the long-rooted turnips the season of maturity is not noted, — a fact in itself suggestive; for the more depressed forms would hardly be noted as 'early,' if they were not earlier than others.

It may be objected to this hypothesis, that a root or bulb that grows in a round or flattened form would naturally sooner acquire the requisite size for table use than one that grows long and slender, and that this fact alone is not sufficient to indicate a physiological relation between the form of the root and its time of maturity. The time of the first bloom, and the first ripe seed in different varieties, mark definite stages of development, which, we may assume, are less dependent upon the influence of selection. If, therefore, we find that the time of bloom and of seed maturity bear a relation to the form of the root, we have additional evidence in favor of our hypothesis. We have gathered from records of the station such data as bear upon the point, with the results noted in the following table: —

	No. of varieties.	Average days to first bloom.	Average days to first ripe seed.
Radish (1883).			
Turnip-rooted	6	$57\frac{1}{3}$	$116\frac{1}{2}$
Long-rooted	7	$57\frac{6}{7}$	$123\frac{5}{6}$
Radish (1884).			
Round, or turnip-rooted . .	22	$60\frac{7}{10}$	108
Long-rooted	22	63	$112\frac{1}{2}$
Beet (1883).			
Turnip-rooted	3	$57\frac{2}{3}$	112
Long-rooted	1	59	116
Carrot (1883).			
Short-rooted	2	52	119
Long-rooted	1	69	122

In the radishes, those have been called 'long-rooted' in which the axial diameter exceeded the transverse diameter. In the beet and carrot the division was necessarily more arbitrary, but the shortest-rooted varieties were called respectively 'turnip-shaped' and 'short.' It is evident that the figures given in the table sustain the hypothesis, so far as they go. Observations made in the station garden upon many varieties of beet, carrot, onion, radish, and parsnip, indicate, that, in general terms, the degree of earliness is proportionate to the degree of 'flatness' of the root, though exceptions are not very uncommon.

Should further evidence establish this hypothesis, we have a valuable guide for selection in producing new varieties. We may not only hope to increase our earlier varieties by selecting the more flattened roots; but by rendering the roots of the earliest long varieties short through selection, or possibly through influence of cross-fertilization, we may reasonably hope to secure earlier varieties than have as yet been obtained. For example: the 'early long scarlet' radish, though it has a long slender root, is scarcely less early than the 'early scarlet turnip-rooted.' It would appear, therefore, that in this variety we have a parent for an earlier radish than is at present known. The roots of this variety vary considerably in thickness as compared with the length. By selecting for seed through a series of generations the roots having the greatest proportional diameter, we may hope to promote earliness. Experiments in this line are already in progress at our station.

EMMETT S. GOFF.

N. Y. agricultural experiment-station.

Domes mounted on cannon-balls.

The chief objection urged against the mounting of rotatory domes on cannon-balls is the difficulty experienced in keeping the balls at equal distances apart. If the dome is much used, this objection becomes a serious one; and no dome so large that it would require more than four balls should be mounted in this manner. If the sill and the bed-plate of the dome are so well built that they retain their figure sensibly perfectly, and the track is kept thoroughly clean, the balls will ordinarily not be found to change their relative position very much, except during the winter season. At this time of the year, and under favorable conditions of temperature, the fine snow which is often driven into the observatory, underneath the dome, will, if allowed to remain in the track, form an icy coating over the balls as they pass through it, no matter what the weight of the dome may be. Under such conditions, if the dome is forcibly moved, the incrusted ball will often change its relative position several feet, thereby perhaps imperilling the safety of the dome.

DAVID P. TODD.

A NEW PLAN FOR THE SCIENTIFIC ASSOCIATIONS OF BOSTON.

A SHORT time ago we referred to the difficulty of obtaining a reasonable attendance at the meetings of scientific societies in Boston, and found one obstacle to be the comparative infrequency with which our scientific men come into general contact with one another and with the public. To-day we propose one external remedy, which may serve in time to better this state of things by multiplying the opportunities, and so increasing the chances of contact. By it we believe that not only science, but the whole community, will be the gainer.

Our plan consists in the concentration of the principal scholarly institutions of the city in a

quarter most readily reached from the suburbs, where most of the members reside. Apart from Cambridge, the members are far more largely distributed, than elsewhere, along the lines of the two railways which have their stations in the 'Back-Bay' district; and this region will be directly entered by the new bridge which is to connect Cambridge with Boston. The Massachusetts institute of technology with its Society of arts, the Boston society of natural history, and the Medical school of Harvard college, are already there. Here, too, is the Museum of fine arts; and, most important of all, to it will shortly be removed the Public library. The square containing the Medical school and the site secured for the Public library has remaining upon it a vacant lot large enough for a building answering all probable needs, and seemingly reserved for this very purpose. It is not, however, the only available place.

Here, then, let us construct a fire-proof building of fair proportions and creditable aspect, having one long side, removed from the street, devoted to a well-lighted book-stack, and the rest to larger and smaller halls and offices. Each floor could be devoted to a single institution, with its portion of the book-stack to itself; or it might be shared by two or more smaller societies, which could choose whether they would economize their resources, — perhaps by placing their libraries under one administration, perhaps by occupying on successive evenings the same meeting-room, — or whether they would remain as independent as if in a separate building of their own. By relegating the larger part of its library to its share of the stack, each society, with its choicer books and its special appurtenances, could make its own apartment doubly as attractive as now. If feasible, a common periodical room could attract the readers of all the societies. Each story should be quickly accessible by an elevator. The rooms should be heated by steam, and every assembling-room have, in addition, an open fireplace.

Under this hospitable roof should be gathered, first of all, the American academy of arts and sciences. With its more than twenty thousand volumes, it has altogether outgrown its present illy ventilated gloomy quarters, and must, perforce, soon take its flight to roomier parts. Next, the Massachusetts historical society, the aged members of which have now to climb three flights of spiral staircase to attend a meeting, or consult a book, in a building soon likely to be taken from them by the city, and where its precious collections of some thirty thousand volumes are endangered by the immediate proximity of a theatre. Next, the collections of the Boston medical library association (fifteen thousand volumes), now including the library of the medical school, where nearness to this school would advantage all parties. Next, the library of the Boston society of natural history (some twenty-five thousand volumes), which has outgrown its present quarters, and which would be more useful in closer proximity to other libraries than in immediate relation to its museum: this, however, being already in that general vicinity, is less important for the plan. Finally, this building should accommodate, for meeting-room at least, if not also for their smaller libraries, other societies of kindred aim, some already quartered, others in search of an abiding-place, — the Society of arts, the Appalachian mountain club, the Boston society of architects, the American society for psychical research, the Boston branch of the Archaeological institute of America, the New-England meteorological society, etc.

Then there is a nameless unorganized scientific club in the city, which has monthly dinners here and there, and whose members come together merely to meet or to honor a guest from a distance. Could this be enlarged, organize, and have its headquarters in this building, it would give additional reason for adding a restaurant to the attractions of the place, where, from among the frequenters of these associated (but not amalgamated) libraries, from those who visit the Public library for research, from among the out-of-town instructors of the medical school and the technological institute, one would daily meet at luncheon or

at dinner some agreeable companion. A conversation-room could be added, and the place become a general rendezvous for scientific and literary men; and these rooms could be so arranged as to admit, on precious occasions, of being thrown together, so as to banquet a Huxley, a Helmholtz, or a Pasteur in a suitable place and manner.

If we look for a suitable name to give to the edifice which shall be the free home of the arts and sciences in Boston, what can better represent its local history, its exalted science, its 'divine' art, than the name of 'BOWDITCH'? 'Bowditch hall,' then, let it be; and let those in Boston, and they are many, who honor the sciences and love the arts, make this more than a name, and help the advancement of all these varied institutions at once by securing them a common and a fitting home. The societies can doubtless bear a part of the expense; but the plan is too large for them to carry out unaided, too fair to fail. What other plan could promise such solidarity of all high interests? What better fitted to restore the ancient prestige of Boston's name?

IS THERE A CORRELATION BETWEEN DEFECTS OF THE SENSES?

PEOPLE sometimes assume that a defect of any important sense is balanced to the individual by the increased perception of the remaining senses. For instance: it is often thought that deaf persons have better eyesight than those who hear, and that blind persons have better hearing than those who see. The returns of the tenth census of the United States (1880) concerning the defective classes show clearly the fallacy of such a belief. They indicate that the deaf are much more liable to blindness than the hearing, and the blind more liable to deafness than the seeing.

About one person in every thousand of the population is blind, and one in every fifteen hundred deaf and dumb. Now, if these proportions held good for the defective classes themselves, we should expect to find one in a thousand of the deaf-mute population blind, or one in fifteen hundred of the blind population deaf and dumb: in other words, we should expect to find no more than thirty-four blind deaf-mutes in the country; whereas, as a matter of fact, no less than four hundred and ninety-three blind deaf-mutes are returned in the census.

In the following table, I., I present an analysis of the doubly and trebly defective classes. The information has been compiled from the published statements of Rev. Fred. H. Wines (who had charge of the department of the census relating to the defective classes[1]), supplemented by unpublished information kindly furnished by the census office.

TABLE I.

Analysis of the defective classes as returned in the tenth census of the United States (1880).

Singly defective.		
Deaf and dumb[1]	30,995	
Blind	46,721	
Idiotic	73,370	
Insane	91,133	
Total singly defective	....	242,219
Doubly defective.		
Blind deaf-mutes	246	
Idiotic deaf-mutes	2,122	
Insane deaf-mutes	268	
Blind idiots	1,186	
Insane blind	528	
Total doubly defective	....	4,350
Trebly defective.		
Blind idiotic deaf-mutes	217	
Blind insane deaf-mutes	30	
Total trebly defective	....	247
Total defective population	....	246,816

[1] The 'deaf and dumb' have no other natural defect save that of deafness. They are simply persons who are deaf from childhood, and many of them are only 'hard of hearing.' They have no defect of the vocal organs to prevent them from speaking. A child who cannot hear our language with sufficient distinctness to imitate it remains dumb until specially instructed in the use of his vocal organs. In the above table, the 'deaf and dumb' are therefore classified with those having a single defect.

In the following tables, II.-VII., I have reduced these figures to percentages.

TABLE II.

Percentage of the population of the United States who are defective.

	Totals.	Percentage.
Deaf and dumb	33,878	0.0675
Blind	48,928	0.0975
Idiotic	76,895	0.1533
Insane	91,959	0.1833
Defective population	246,816	0.4921
Population not defective	49,908,967	99.5079
Total population	50,155,783	100.0000

[1] See *American annals of the deaf and dumb* for January, 1885.

TABLE III.

Percentage of the deaf-mute population who are otherwise defective.

	Totals.	Percentage.
Deaf-mutes returned as also blind . .	493	1.45
Deaf-mutes returned as also idiotic .	2,339	6.90
Deaf-mutes returned as also insane .	298	0.88
Deaf-mutes returned as otherwise defective	2,883	8.51
Deaf-mutes returned as simply deaf .	30,995	91.49
Total deaf and dumb	33,878	100.00

TABLE IV.

Percentage of the blind population who are otherwise defective.

	Totals.	Percentage.
Blind persons returned as also deaf and dumb	493	1.01
Blind persons returned as also idiotic,	1,403	2.87
Blind persons returned as also insane,	558	1.14
Blind persons returned as otherwise defective	2,207	4.50
Blind persons returned as simply blind	46,721	95.49
Total blind	48,928	100.00

TABLE V.

Percentage of the idiotic population who are otherwise defective.

	Totals.	Percentage.
Idiots returned as also deaf and dumb,	2,339	3.04
Idiots returned as also blind	1,403	1.82
Idiots returned as otherwise defective,	3,525	4.58
Idiots returned as simply idiotic . .	73,370	95.42
Total idiots	76,895	100.00

TABLE VI.

Percentage of the insane population who are otherwise defective.

	Totals.	Percentage.
Insane persons returned as also deaf and dumb	298	0.32
Insane persons returned as also blind,	558	0.61
Insane persons returned as otherwise defective	826	0.90
Insane persons returned as simply insane	91,133	99.10
Total insane	91,959	100.00

TABLE VII.

Percentage of the doubly defective who are also trebly defective.

Of 493 blind deaf-mutes, 217, or 44.02 %, are returned as also idiotic.
Of 493 blind deaf-mutes, 30, or 6.09 %, are returned as also insane.
Of 2,339 idiotic deaf-mutes, 217, or 9.28 %, are returned as also blind.
Of 298 insane deaf-mutes, 30, or 10.07 %, are returned as also blind.
Of 1,403 blind idiots, 217, or 15.47 %, are returned as also deaf and dumb.
Of 558 insane blind persons, 30, or 5.38 %, are returned as also deaf and dumb.

The tables seem to indicate that in the case of deafness, blindness, idiocy, and insanity, some correlation exists; for persons having one of those defects appear more liable to the others than persons normally constituted, and doubly defective persons appear to be more liable to be otherwise defective than persons having a single defect. For instance: —

(*a*) Of 50,155,783 persons in the United States, 246,816, or 0.4921 %, are defective.
(*b*) Of 246,816 defective persons, 4,597, or 1.86 %, are doubly defective.
(*c*) Of 4,597 doubly defective persons, 247, or 5.37 %, are trebly defective.

The results obtained above, I think, merit the consideration of scientific men, and are calculated to throw light upon the subject of correlated defects.

Although the proportion of the insane who are deaf or blind is abnormally large, the evidences of a correlation between insanity and the other defects noted above are not well marked; but in regard to deafness, blindness, and idiocy, a marked correlation appears to exist.

1. *Deaf-mutes.* — There are fourteen and a half times as many blind persons among the deaf and dumb in proportion to the population as there are in the community at large, and forty-six times as many idiotic.

2. *Blind.* — There are fourteen times as many deaf-mutes among the blind in proportion to the population as there are in the community at large, and nineteen times as many idiots.

3. *Idiotic.* — There are forty-three times as many deaf-mutes among the idiotic in proportion to the population as there are in the community at large, and eighteen times as many blind.

The apparent correlation between deafness, blindness, and idiocy, may possibly indicate that in a certain proportion of cases these defects arise from a common cause, perhaps arrested development of the nervous system.

It is of course possible that some of the persons returned as 'blind deaf-mutes' may

have lost sight and hearing from the same disease. The returns have not yet been sufficiently analyzed to enable us even to separate the congenital from the adventitious cases. We cannot therefore tell at the present time how far the evidences of correlation may be weakened by a closer inspection of details.

The large number of deaf-mutes who have been classified as idiots, also suggests caution in accepting the returns. I recently met a young lady — one of the brightest and best pupils of the Illinois institution for the deaf and dumb — who commenced her school-life in an idiot-asylum. She was there discovered to be simply deaf, and was transferred to the Institution for the deaf and dumb at Jacksonville, where she not only received a good education, but was successfully taught to speak. Not only are children who are simply deaf, sometimes sent to idiot-schools; but idiotic children who hear perfectly are often sent to institutions for the deaf and dumb, when it becomes the painful duty of the principal to undeceive the parents as to the real condition of their child. The difficulty in distinguishing these two classes of defective persons arises from the absence of articulate speech. Children who are deaf from infancy, and idiots, do not naturally speak, but from very different causes. In the one case, the cause is lack of hearing; in the other, lack of intelligence. The judgment of unskilled persons regarding the intelligence of deaf-mutes should evidently be received with caution. It is only to be hoped that the number of idiotic deaf-mutes returned in the census has been over-estimated. Before accepting the results as thoroughly reliable, it would be well to know whether or not the persons who made the returns were competent to judge in the matter.

ALEXANDER GRAHAM BELL.

EARTHQUAKE OF JAN. 2, 1885.

THE daily papers of Jan. 3 contained reports of a slight earthquake in Maryland and Virginia the previous evening.

On Jan. 4 circulars of inquiry were sent to more than twenty places in the vicinity of the reported shock. The questions asked had reference to the time of the shock, its duration, number of shocks, character of accompanying noise, and intensity according to a given scale. It will be necessary here to quote only the first three of the six numbers of this proposed scale of intensity, which are as follows: —

No. 1. *Very light.* — Noticed by a few persons, but not generally felt.

No. 2. *Light.* — Felt by the majority of persons, rattling windows and crockery.

No. 3. *Moderate.* — Sufficient to set suspended objects (chandeliers, etc.) swinging, or to overthrow light objects.

In response to this circular, seventeen written reports, and a copy of the Leesburg *Mirror*, were received; and from these replies, together with reports in the New-York *Tribune* and in *Science*, a tabulated summary was prepared, and represented graphically upon the accompanying map, on which are marked all the places from which any report, either manuscript or press, was at hand.

As is there shown, the northern boundary of the region affected is well determined by manuscript reports from five places lying beyond its limits. The inquiries, which might have determined its limits as clearly in other directions, failed to elicit any response. It appears to have extended very little, if at all, west of the mountains. The only direct report obtained from that region was from Boonesborough, Md., where it was felt *near*, but not *in*, the town. The Leesburg *Mirror* stated generally that it was felt in Jefferson county, W. Va., but no reply was received to circulars sent there.

The closest approximation to the true time is probably 21 h. 12.1 m. eastern time, as given by W. C. Winlock at Washington, D.C., with which agree also the reports of W. J. Grove at Lime Kiln, Md., and W. H. Routzahn at Middletown, Md. These are the only reports which vary from 21 h. 10 m. or 21 h. 15 m., except Fairfax, Va., which is 21 h. 5 m., and W. H. Dall at Washington, who gave 21 h. 16 m. At Adamstown, Md., two shocks were reported; and at Buckeystown, Md., a second very light shock at 21 h. 45 m.

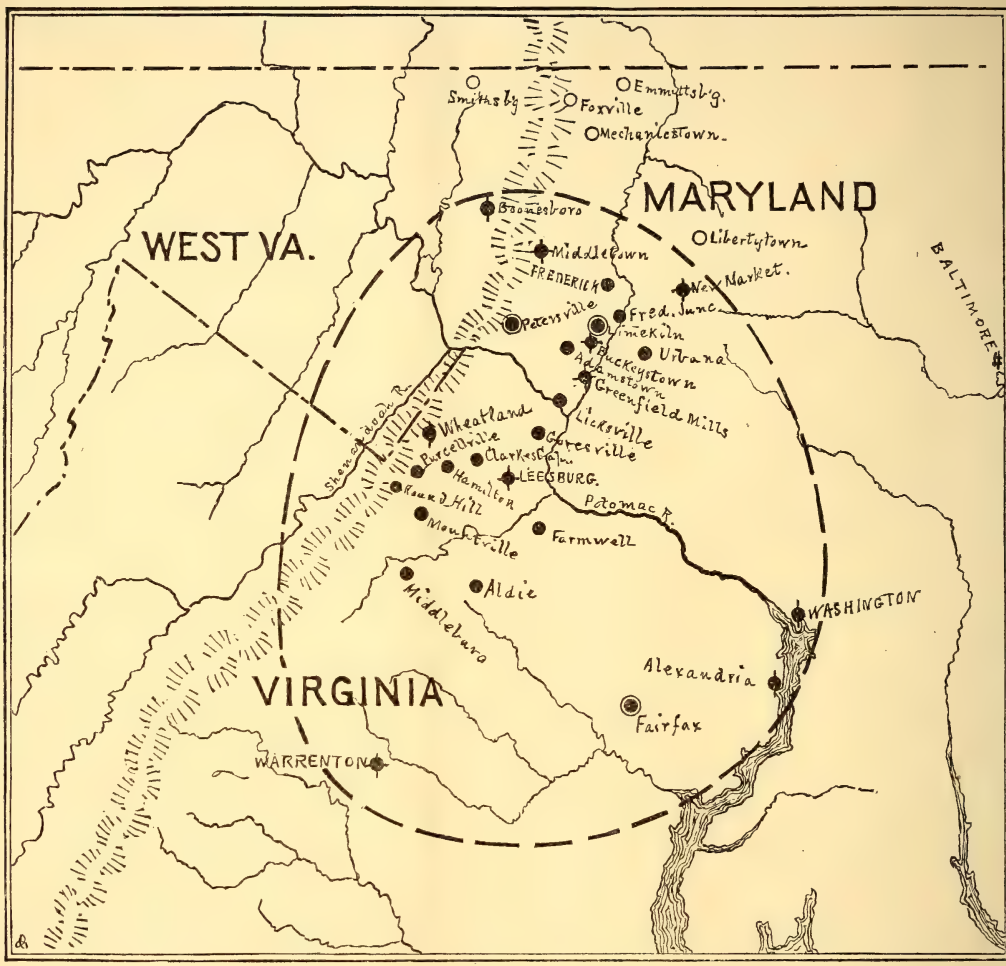
The estimates of duration were, as usual, very discordant, varying all the way from three seconds to two minutes. As the tendency of ordinary observers is always to exaggerate this element, the unexpected and exciting nature of the phenomena making the time seem longer than it really is, probably ten or fifteen seconds would be a liberal estimate of the duration.

The noise accompanying the shock was compared to that made by a loaded wagon passing rapidly over frozen ground or over a bridge, to distant thunder, and to the roaring of a chimney on fire. In some cases persons went out of their houses to see if their chimneys were not burning.

The shock seems to have been most severe in the southern part of Frederick county, Md., where, at Petersville and Lime Kiln, it reached No. 3 of the proposed scale. At most places it did not exceed No. 2, and it is therefore called above a 'light' shock. There are some indications, also, of a focus of increased intensity in the southern part of the area affected, as shown by the reports from Warrenton and Fairfax, Va., but no confirmation of these was obtained.

The limits of the shock and its intensity at various places, so far as reported, are indicated by appropriate symbols upon the map, to which the reader is referred.

C. G. Rockwood, Jun.



○ Not felt. Very light. Light. ⊙ Moderate. ● Not reported.

EARTHQUAKE, JAN. 2, 1885, 9 H. 12 M., P.M.

AMERICAN MILK.

Some interesting facts have come to light, during the investigations, by the U. S. agricultural bureau of chemistry, of the composition of milk. The object of the investigation is to determine by large numbers of analyses made under uniform conditions, and on samples from various sources, the average constituents of American milk. The work which has been done up to this time has been mostly of a local nature, but sufficiently extensive to give value to the results obtained.

The specific gravity of milk is 1.030. When the cream has been removed, this number is larger. Twelve samples of milk from Mr.

G. L. Higby gave an average specific gravity of 1.0295. Two samples of a Jersey cow's milk sent by the commissioner of agriculture marked 1.033. The milk from Mr. W. Blair, of a cow fed principally on ensilage, twenty-two samples, gave specific gravity 1.0318; same cow fed 'chop food,' fifteen analyses, 1.310. It is a very common practice to remove the cream, and then add water until the milk is reduced to its original density. For this reason the use of the lactometer for determining the purity of milk may lead to serious error. It is also true that perfectly genuine milk may vary greatly in density. The first of the milking is always poorer in cream, and therefore denser, than the last. Unless, therefore, the conditions under which the sample of milk is obtained are known, the number expressing its density is not conclusive in respect to its genuineness.

The volume of cream which a given milk will afford depends on many conditions. Transportation, shape of vessel, temperature, and time allowed for cream to rise, are the chief causes which affect the cream volume. A remarkable decrease in the volume of cream has also been noticed in milk samples purchased in open market. Thirteen samples bought in open market showed a percentage of cream of seven. Thirty-four samples bought of the dairyman, and known to be genuine, gave fifteen per cent of cream by volume. This curious phenomenon will certainly be of interest to milk-buyers.

The fat in a milk is not always in proportion to the volumetric percentage of cream: therefore the determination of the fat (ether extract) gives a better index of the butter-making value of the milk than is afforded by the volume of the cream alone. In a hundred and seven analyses the average percentage of fat was nearly five.

The sugar is the most constant constituent of milk. Over two hundred analyses show an average percentage of sugar of milk of four and six-tenths. Its determination optically is quick and accurate. It is the safest single criterion by which to judge of the purity of the sample.

The caseine of milk is composed of several albuminoids. No attempt at separation of these bodies has been made. The average percentage of albumens in American milks is markedly less than in those of other countries. In the analyses made, the average per cent is nearly three and a half. These analyses show that the milks of the United States are better adapted for butter than for cheese making. They are characterized in general by a large percentage of fat and sugar, and a lower content of albumen, than the milks of Europe. It is the intention of the bureau to extend these analyses so as to determine the localities of the country where the best milks are produced, to note the influence of change of season on the composition of the milk, and to carefully study the characteristics of the milk of different breeds of cows, and the influence of various foods thereon.

Much of the value of analytical work on milk which is done in this country is lost on account of the many different methods of analysis employed. These different methods render it impossible to compare the work of various analysts. The bureau hopes also, by a patient trial of all the most approved methods, to be able to unite the analysts of the country on that procedure which a large experience may pronounce the best. H. W. WILEY.

NOTICE OF SOME RECENTLY DISCOVERED EFFIGY MOUNDS.

So few earthworks resembling animals in their shape are known beyond the limits of Wisconsin, that I send you an account of several which I have discovered during the past two seasons, the majority of which are situated south of St. Paul, twenty-five of them being in this state.

In the diagrams accompanying this article, I have shown the outlines of a few of the most interesting of these Minnesota effigy mounds, and here give a short description of each, with its surroundings. They are all reduced to the same scale, 1 : 500.

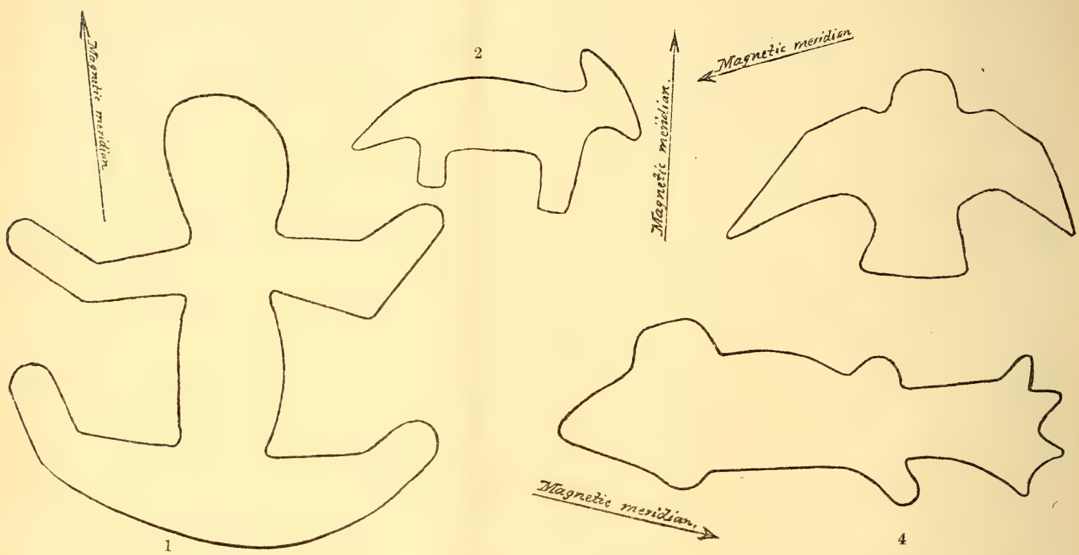
No. 1 is situated near the village of La Crescent, and probably represents a frog. Its greatest length is ninety-eight feet. The body is two feet high, and the head eighteen inches. Near it is a bird-effigy; and within a quarter of a mile there are five other bird-effigies, with sixty-nine round mounds and embankments. The frog is on a terrace about fifty feet above the Mississippi River; and part of the mounds are on the lower terrace, which is about thirty feet above the river.

No. 2 is on the town site of Hokah. It is situated on a terrace some seventy feet above Root River. From the extremity of the snout to the tip of the tail, its length in a right line is just sixty-two feet and a half, and the body is a foot and a half in height. There are two bird-effigies on a terrace some ten feet below this one. Formerly there existed sev-

eral other effigies, and thirty or forty mounds and embankments, on the same terrace with the birds, which have been removed in grading streets and lots.

No. 3 is near Richmond Station, on a terrace about twenty-four feet above the river. It is seventy-six feet in an air line from tip to tip of the wings; and the body, with head and tail, is forty-four feet in length. The body, to the first joint of the wings, is fifteen inches in height. Formerly a number of ordinary mounds existed in the immediate vicinity of this effigy.

No. 4 is situated near the village of Dakota, upon a terrace about thirty feet above the river, and is in the midst of nineteen ordinary mounds. Its length is a hundred and ten feet, and the centre of the head is two feet and a half in height. It undoubtedly represents a fish. This is the first case that has been discovered of a fish with fins.



In the limited territory hitherto examined by me in south-western Wisconsin, it would seem, from the numerous ruined effigies, that there formerly existed hundreds of such works. Judge Gale of Galesville estimated that there were fully one thousand effigies in the southern part of Trempeleau county alone; and, from my own observations, I should say a like estimate for Vernon and Crawford counties would be rather under than over the truth. Taking Judge Gale's estimate for Trempeleau county, and reducing it one-half, there would still remain more effigies in the one county than can be enumerated from all the published surveys together.

The effigies surveyed by myself, in addition to the twenty-five in Minnesota, are one in Iowa, and ninety-six in Wisconsin, — a total of a hundred and twenty-two to the present time. On critically examining their delineations, very important differences in class and style from those farther east, portrayed in Lapham's work, are discernible; so that one is irresistibly drawn to the inference, that, before generalizations of value can be made, ten times the number of facts now recorded must be gathered together. Unfortunately, however, that fell destroyer of antiquities, the plough, annually narrows our field of research.

In conclusion, something might be said on the question of the relation between any relics contained in this class of mounds and their shapes. The fact is, however, that little, if any thing, has been understandingly done with a view to ascertain their contents. The few effigies opened along the Mississippi have shown relics and forms of interment similar to those of the common burial-mounds of their neighborhood.

T. H. LEWIS.

RICHET ON MENTAL SUGGESTION.

IN the *Revue philosophique* for December, Mr. Richet gives an account of some experiments in mental suggestion, and attempts to estimate their value by means of the theory of probabilities. Men-

tal suggestion is Richet's contribution towards the task of naming the new phenomenon which is just now struggling for recognition, and which has been hitherto variously designated as 'thought-transference,' 'mind-reading,' and 'telepathy.' 'Thought-transference,' it strikes us, is the worst of these names, and 'telepathy' the best; but, as it is desirable that a phenomenon should not be too rigidly named before it is known what the phenomenon is, we shall make trial for the present of the new term, 'mental suggestion.'

Richet says very happily that the courage of the scientific man consists not only in making experiments dangerous to life upon cholera, rabies, and the liquefaction of gases, but also in exposing his reputation to blemish by advocating a theory which is generally discredited. Richet has taken his courage in his hand, and has published an article in which he claims to have established a strong probability in favor of mental suggestion. We venture to believe that the careful reader will come to the conclusion that to offer such unsatisfactory experiments, so inadequately treated, was a greater strain upon his courage than the novelty of what he attempts to prove. The Society for psychical research has already established a strong presumption in favor of mental action at a distance. Richet's experiments are not to be compared with those of the society, either in the care with which they were performed or the accuracy with which they are described; and his unfamiliarity with the theory of probabilities renders his numerical deductions, except the most obvious ones, misleading and useless.

The experiments are mainly of four kinds, — guessing the suit of a card drawn at hazard from a full pack, guessing a photograph drawn at hazard from a set of six, finding a watch hidden under one of several orange-trees by means of the vibrations of a stick, and spelling out names by means of table-rappings. There is a great deal that is interesting and suggestive in these experiments, and it is a pity that they are not more convincing. It will hardly be believed that in guessing cards the author does not state whether the two persons engaged in the experiment are in contact or not. Such remarkable things are done nowadays in any parlor by muscle-reading, that no experiment in which there is contact is of the slightest weight in establishing mental suggestion. Certain precautions, the author says, are indispensable, — the cards should be a full pack; the one drawn should be returned after each trial; the person who looks at the card should abstain from every word, from every indication, however imperceptible it may be, — but he omits to say whether he is hand in hand with the person who guesses or not. Doubtless he is not; but an experiment in which so essential a circumstance as this is left to be inferred by the reader is not the kind of experiment that carries conviction with it. The conditions under which the photographs were guessed remain equally undescribed; but the remark, "It is necessary to eliminate every sign, whether in the direction of the eyes or in the expression, by which an indication can be given," makes it plain that the simple precaution of putting the performers in such a position that it should be impossible to give any indication by the expression or the direction of the eyes, was not attended to. We pass over the experiments in finding a watch hidden under orange-trees, for the reason, that, in order to attribute any weight to them, it would be necessary to know, among other things, where the person stands who has hidden the watch, and whether the one who finds it is blindfolded or not. That the experiments were performed in a garden in the environs of Paris, that the orange-trees were cultivated in boxes, and that they stood in two rows, are the only details that are given.

The last series of experiments was made by Richet and five of his friends, — friends from infancy, intelligent men, well-instructed, and not at all mystical, — two of whom are mediums. Three of these men sit at one table, — the rapping-table, — and two, A and B, at another. Some one thinks of a name. A moves a pencil along an alphabet which is on the table in front of him; when he reaches a certain letter, the other table, by rapping, rings a bell, and B writes down the letter indicated. In this way something like the name thought of is written down, — Jeanr for Jfard, Foqdem for Esther, Dierooreg for Cheuvreux, and, the only very good one, Cheval for Chevalon. The person who has the name in his mind *n'est ni à la table ni à l'alphabet;* but, to such a degree does Mr. Richet's talent for incomplete description pursue him, it is not said that he is standing where he cannot see the alphabet. If that is the case, the experiment is a very extraordinary one, totally different from simply divining what another person has in his mind. The medium, who sits laughing, talking, and singing with his friends, is required to give his table a vigorous shaking at the instant that two persons near him, who are thinking of the letters of the alphabet, happen to think of the same letter. Such magic as this throws even the ghosts of the English society into the shade; and the observer will need to pile Pelion upon Ossa by way of proof, before he can hope to gain credence for it.

Admitting that Richet's experiments were performed with a rigor with which they are not described, his estimation of the improbability of their results arising by chance falls far short of the truth. He says, after combining the results of all his experiments, — those made with mediums, with 'sensitives,' and with the non-hypnotizable, — that the probability in favor of mental suggestion may be represented by $\frac{1}{3}$. This number is the ratio of the difference between the actual number and the probable number of successes to the whole number of trials. But a comparison of this sort affords no measure of the improbability of the observed facts being the result of chance. It is not the deviation from an average, but the probability that a given deviation should arise, that gives the value of the evidence in favor of the operation of a cause. Richet does not seem to know that there is a mathematical formula by which this probability is determined. For instance: in three series of experiments in guess-

ing cards, he made, in all, 2,927 trials, and obtained 789 successes instead of 732, which is the number that chance alone would lead him to expect. The probability that the actual number of successes shall differ from the probable number in either direction by so much as 57 in 2,927 trials (by λ in s trials, say) is approximately, —

$$1-\frac{2}{\sqrt{\pi}}\int_0^{\frac{\lambda}{\sqrt{2pqs}}} e^{-t^2}\,dt,$$

which gives in the present case $\frac{1}{70}$; that is to say, there is in reality one chance in seventy of so great a deviation arising by accident, while Richet would make it fifty in fifty-one.

We repeat that many of Mr. Richet's experiments are interesting, and the results very striking. It is a pity that they are not more effective than they are in placing the question of mental suggestion upon a scientific basis. CHRISTINE LADD FRANKLIN.

THE DIMENSIONS OF SHIPS.

I HAVE often thought, that, in practising the art of ship-building, men have too much neglected the study of the forms of the fish which make the waters their permanent habitation, and are designed for the most part to attain the highest degree of velocity in the pursuit of their prey. No doubt, the case of a ship partly, and that of a fish wholly, immersed, are not strictly parallel; but they offer very many points for comparison of which we may avail ourselves.

A fish makes use of its tail-fin as the chief and nearly sole instrument of propulsion; and, in the adoption of the screw-propeller in preference to the old side-wheels, the steamers of the present day have secured a great advantage over the old forms. In the proportion of length to those of breadth and depth, however, although there has of late been some improvement, there would appear to be a lingering tendency to hold by the old mistaken idea that a ship was rather to be regarded as a wedge to cut the water than as occupying the space of a wave of displacement; and so we have ships nine, ten, or even eleven times as long as broad, and twenty times the length that they have draught. Now, knowing as we do the magnitude of the skin-resistance in ships, and its smallness in the oily coats of fishes, one would expect that the length of the latter would be greater proportionally than that of the former, if ships were built in the proper form to secure a high velocity. But what is the fact? On an average of sixteen fresh-water fish delineated in Daniell, I find that the extreme length, inclusive of the tail-fin, is four and twenty-two hundredths times that of the extreme depth exclusive of the dorsal and ventral fins. The average breadth will be perhaps one-half of the depth, making the proportion to length about 1:8.

Abstract of a paper by Dr. J. P. JOULE, published in the Proceedings of the Manchester literary and philosophical society.

On an average of three species of whale, the narwhal, Greenland shark, dolphin, and the porpoise, I find from Scoresby and other authorities the proportion of either depth or breadth to length to be about 1:4.7, they having nearly circular sections. Therefore it appears, that, while in ships the proportion of length to width of midship immersion is 5:1, that of the shark, the porpoise, or dolphin, is not more than 1.5:1.

Dr. Scoresby, in his 'Arctic regions,' gives twelve miles per hour as the utmost speed of the whale; but Mr. Baxendell gives it a velocity approaching twenty miles. I had an opportunity of witnessing the wonderful swimming-powers of the porpoise during a voyage to the Clyde in the Owl steamer on the 29th of June last. About eight A.M., the sea being calm near the Mull of Galloway, we were beset by a shoal of these animals, which raced with the ship, and kept alongside for three or four minutes with the greatest ease. They swam in twos and threes, at a foot or two distant from one another, several approaching within ten feet of the vessel, which was steaming at the rate of thirteen and four-tenths statute miles per hour. If such a velocity can be maintained by the porpoise, with its comparatively bluff figure-head, we may surely expect a much higher velocity in the case of fish more obviously designed for speed.

My son tells me that in a voyage of the Malvina from Leith to London he had observed at night two fishes of about a yard long which kept for a considerable time in advance of the cutwater of the ship, being visible by their phosphorescent light. The ship was at the time steaming at the rate of fifteen and two-tenths statute miles per hour.

The investigation of the resistance of solids moving in fluids has been taken up theoretically by Thomson, Stokes, Rankine, and practically by Froude, who has found that the surface friction in long iron ships is more than fifty-eight per cent of the whole. Froude recognized the study of the forms of animal life in guiding us to practical conclusions.

From the above considerations, I am inclined to believe that a length of not more than five to one of breadth would be better than the extreme proportions of ships now in vogue, and that the greatest breadth should be considerably in advance of the midship.

RECENT TRAVELS IN ARABIA.

FROM the recently printed account of Mr. Charles Huber's mission in Arabia we cull some notes of general interest.

On an excursion to the great mountain Jebel Aga, the party camped at the entrance of the Tuarin valley, near the ruins of the little fortress El Asfar. Three palms grow here; and there is a little spring whose temperature, 75° F., indicates the heat of the soil and rock in this arid region. Around the ruins were traces of cultivation and abandoned wells. At a short distance the traveller was fortunate enough

to make the second known discovery of Himiarite inscriptions, of which there were nine. These were on a block of granite of enormous size, under whose shade travellers have refreshed themselves for many centuries, as these inscriptions, supposed to be more than two thousand years old, sufficiently indicate. They are accompanied by rude outlines of horsemen brandishing the sword and lance, precisely similar to sketches made in Huber's note-book by a living Arab chief at Haïl. It is probable that the first Himiarites established themselves in the Tuarin valley on their southward migration. In the numerous revolutions which have devastated Arabia, it is probable that the valley has been many times depopulated.

Farther on, the party passed a singular rock, which, in falling from the crag, had perched itself on a granite mass by three sharp points. Being somewhat concave below, it resounds like a rather heavy bell to the strokes of a cane, — an infallible sign, according to the Arabs, of concealed treasures. Their camp, a few miles beyond, was in the midst of a remarkable ravine of a uniform width of about fifteen hundred feet, bordered by granite walls about nine hundred feet in height, presenting in the sun remarkable hues of red, violet, brown, and rose. The perfectly level sandy soil was of a peculiar rose color, and the impression conveyed was of a gigantic street newly swept and silent. Access to the Gou valley was obtained through a very narrow ravine encumbered with fallen blocks, hardly affording passage for a camel. Above this it enlarges into a circular plateau continued on the other side by a long boulevard of magnificent palms. The spot seemed a terrestrial paradise. Flocks of birds, so rare in this parched land, delighted the eye, and their songs broke the silence of the desert in a delightful manner. Vegetation was luxuriant and beautiful; and a flowing spring refreshed the party, though its temperature was not less than 82° F.

In travelling about the Jebel Aga, ascent was found practicable only in a very few places. The walls rise abruptly without foot-hills, and are of a gray, red, or reddish-brown granite of coarse grain composed of quartz, with large crystals of red and white felspar with grains of pegmatite. The dip of the beds is about 55° toward the horizon. The wind in this part of Arabia blows always from the west.

The road passing through the region of Jebel Selma, at no great distance from the Jebel Aga, traverses an isolated volcanic district, where the passage is often only wide enough for single file. Several craters, one twenty-five hundred feet across, still remain, and, though now safe for travellers, were formerly the fastnesses of Arab robbers, whose attacks made the region deserve, even more than its natural character, its Arabian name of Gehenna. Beyond, just where the grits replace the basaltic rocks, lies the little town of Feyd, containing some forty houses. Anciently this was a site of renown, for whose determination Ritter vainly spent many pages of discussion; but its splendor has departed. Around it, at no great distance, are scattered low hills of volcanic origin, in some of which the craters are still evident. Water lies under a bed of basalt, very hard, and six or seven feet thick, covered with about thirty feet of sand and gravel. The wells, singularly enough, are connected by subterranean tunnels. This water, accessible only at the cost of so much labor, must be raised to water the palm-trees, and is reported to be gradually diminishing, to which the decay of the ancient city is probably due. The desert around Feyd is called Aba-el-Krūs.

Thence toward El Kehafah the path traverses a region of volcanic rock, which emerges from the surface on either hand in a singular manner. It looks as if the whole region had been once a boiling liquid lava which had been suddenly congealed, leaving solidified bubbles twenty-five to thirty-five feet in diameter, which appear at every step. A little sand is found here and there in crevices, with an occasional shrub growing in it; but apart from this, the desert is absolutely naked rock of indescribable desolation, — a corner of the real Arabia Petraea. The name of this waste is El Sarâfah. In this region, according to the Arabs, there are some ten rainy days at the beginning of winter: the rest of the year is literally dry. Beyond Kehafah several small oases were seen of a singular geological structure, which is, however, common in the region. They consist of elliptical dish-like depressions, dipping slightly toward the north, their axes north-west and south-east, and about twenty-four kilometres in length by half as much in width. The margins of these basins are abruptly elevated, rocky walls, about thirty or forty feet in height. The wells pass through twelve or fifteen feet of gravel and rock, beneath which is water in abundance, but too bitter to be potable. Drinking-water is accessible in but two or three places. The road from Kehafah to 'Ayoun passes the boundary of the safe country, and enters the region of robber nomads. A singular rock, much resembling the sphinx in form, partly covered with illegible Himiarite and Arabic inscriptions, lies isolated near the route, and beyond a much smaller one, from which a few inscriptions could be transcribed. The inhabitants of this region are small, shrivelled, and sickly-looking, in strong contrast with the fine physique of the people of El Jebel, which the traveller had left. They are violent fanatics, from whom his safe return was fortunate. The mean temperature of the soil here was 84°; and during one day, with a hot wind, the thermometer rose to 122° F. in the shade.

STEAM ON STREET-RAILWAYS.

The Hon. R. C. Parsons recently read a paper before the British institution of civil engineers, in which the progress of steam-locomotion on street-railways was very fully considered. It was asserted that very little success had attended the efforts made to introduce steam as a motor on the common highway, while the privileges accorded by special legislation to the street-railway companies have led to comparatively great success in that direction.

The British 'Board of trade' regulations have

been amended in such manner as to protect the public, without hampering the use of steam. A special type of engine, with vertical cylinders, carried well up above the axles (to secure them from injury by mud and dust, and to make them readily accessible), and fitted with long connecting-rods, coupled directly to the leading axles, has been applied to the street-cars. All four wheels are connected by coupling-rods, as in the locomotive, and the exhaust steam is concealed by various expedients. The surface-condenser was considered more economical than superheating, to produce efficiency, and air-condensers were thought practicable. Engine and passenger-car were often combined, — a method used in various American systems, — in one of which (Rowan's) the engine can be removed, and another substituted, in a few minutes. Depreciation was allowed for at 10 %. Depreciation on the line alone was taken as 3 %. The cost of operation was stated at 2.28 pence per mile, while the total of all expenses was given at 9.33 pence per mile, and every penny per mile above this figure should give 2.2 % in dividends. The line intended for such steam-traffic should be very substantially built, and large cars and moderate fares were advised.

Mr. Shellshear gave an account of the street-railways of Sydney, New South Wales, all of which are worked by the ordinary railway system. The number of passengers carried in 1882, on twenty-two miles of road, was 15,269,100, or about 200,000 per mile; and the earnings were over $40,000 per mile, or about 2 % per mile. The gauge was 4 feet 8½ inches, and the number of motors employed was 57, including several American (Baldwin) tank-engines, which work more smoothly than the English or home-made engines. The government is having other steam-cars, on the American system, built by the Baldwin works. The result has proved that horse-traction must yield to mechanical power.

MORTILLET'S CONCLUSIONS REGARDING EARLY MAN IN EUROPE.

1. During the tertiary age, there existed a being intelligent enough to produce fire and to fabricate stone implements.

2. This being was not yet man: it was his precursor, — an ancestral form, to which I have given the name of the *man-ape*.

3. Man appeared in Europe at the beginning of the quaternary period, at least 230,000 or 240,000 years ago.

4. Our first human type was that of Neanderthal. This type, essentially autochthonous, was slowly modified and developed during the quaternary period, resulting in the type of Cro-Magnon.

5. His industry, very rudimentary at first, developed progressively in a regular manner, without shocks. This proves that the progressive movement went on upon the spot, without the intervention of propagandism and invasion from abroad. It was therefore really an autochthonous industry.

6. The regular development of this industry has enabled me to divide the quaternary period into four epochs, — first, the *chellean*, anterior to the glacial period; second, the *mousterian*, contemporaneous with it; third and fourth, the *solutrian* and the *magdalenian*, posterior to it.

7. Quaternary man, mainly a fisherman, and especially a hunter, was acquainted neither with agriculture nor with the domestication of animals.

8. He lived in peace, entirely destitute of religious ideas.

9. Towards the end of the quaternary period, in the *solutrian* and the *magdalenian* epochs, he became an artist.

10. With the present condition of things, there have come invasions from the east which have profoundly modified the population of western Europe. These have brought thither ethnic elements entirely new, and in great part brachycephalic. To the simplicity and the purity of the autochthonous dolichocephalic race, there have succeeded numerous crosses and mixtures.

11. The industry is found to be profoundly modified. Religious ideas, the domestication of animals, and agriculture have made their appearance in western Europe.

12. This first invasion, which took place at the Robenhausen epoch, set out from the regions of Asia Minor, Armenia, and the Caucasus.

PARKER'S TEXT-BOOK OF DISSECTION.

THIS book is well printed, and presents an attractive appearance. Of the seventy-four woodcuts, all are good, some excellent. The plan of the book is similar to that of Huxley and Martin's 'Elementary biology,' and, like it, is designed as a course of laboratory instruction. Our author deals with the anatomy of the lamprey, skate, cod, lizard, pigeon, and rabbit. It will be seen that the anatomy of a representative form of each of the vertebrate classes except the Amphibia is taken up. A type of this latter group was evidently omitted with purpose, since Huxley and Martin's 'Biology' takes up the anatomy of the frog. The anatomy of the types selected is considered from an independent point of view, and the author makes no attempt whatever to give a detailed or complete account of their structure. He dwells on the more important points, taking up the anatomy in quite as detailed a manner as desirable, and perhaps more fully than can be compassed by the student in most of our laboratories. General directions are given as to instruments, methods of dissection, and preparation, followed by more detailed instructions about dissection of the types con-

A course of instruction in zoötomy (Vertebrata). By T. JEFFERY PARKER, B.Sc., London professor of biology in the University of Otago, New Zealand. With seventy-four illustrations. London, *Macmillan & Co.*, 1884. 23+397 illustr. 8°.

sidered; as, for example, how and where to cut to make out the anatomy of the special parts, and their relations to one another. The directions are clear and concise, and the student will have no trouble either in dissecting or identifying the various parts. We think the introduction of clear woodcuts an important and legitimate aid to the student, and a great improvement thereby over Huxley and Martin's 'Biology.'

The book, in short, is admirably adapted for laboratory work, and furnishes to the student who will take specimens in hand, and dissect with care, a sufficient guide in making out the essential points in vertebrate anatomy.

RECENT PHYSIOLOGICAL TEXT-BOOKS.

Hutchison's physiology has been before the public for some time, and apparently has met with considerable success as a school text-book. The revised edition that is now offered has but few changes. The book as a whole is commendable as a collection of facts, physiological, anatomical, and hygienic, a knowledge of which will be useful to people of all callings in life. But it is questionable whether it is a book that a thoughtful physiologist would like to see generally introduced into schools as a text-book. No chemist at the present time would wish to have an elementary text-book of chemistry merely a collection of facts or receipts, however interesting and useful such facts might be. The demand is being made in that branch of science for text-books of a higher order, which shall make the facts presented, as far as possible, illustrations of the more important general laws of chemical action. Some such reform should be attempted in elementary text-books of physiology. Physiology is worthy of being taught, in part at least, as a branch of human knowledge, or for the sake of mental training, and not simply for the purpose of preserving health, or enabling a person to conduct himself properly in case of an accident.

The remarks upon personal hygiene in the book are in the main well chosen and to the point; but, in regard to the action of alcohol, the author's prejudices, or desire to do good, have evidently biassed his statement of facts. The book contains a number of errors which should be corrected; such as, "sugar changes to fat in the body," "the acidity of the gastric juice is due to lactic acid," and the rather incomprehensible statement that albumen gives 'smoothness and swift motion' to the plasma of the blood. Another error common to both books under review is, that the proteids of the blood are spoken of as albumen and fibrine. There is no such thing as fibrine in circulating blood; and, if it is necessary to mention at all the chemical constituents of the plasma, something a little more in accord with what is actually known might be given.

Tracy's book aims to be a more scientific presentation of the facts of physiology and hygiene than is usually met with in elementary text-books; but whether the result has fulfilled the author's expectations is one of the things that might be doubted. It is scarcely scientific, for instance, to speak of alcohol as a 'rank poison,' without any qualification whatever. While such language is expected from a temperance orator, it is somewhat out of place in an elementary book supposed to give generally accepted facts. Quite enough can be said truthfully against the use of alcohol without making statements which are not borne out by the facts of physiology.

The book has some serious defects, such as the failure to say any thing at all of the function or structure of the kidneys, except in a purely incidental way. It contains also numerous errors or badly emphasized statements; such as the origin of lymph (p. 88), the action of the sympathetic nerves (p. 175), the mechanism of the reflex secretion of saliva (p. 178), the statement that all bones are at one time cartilaginous, etc. Some of the chapters — that on respiration, for instance — are well written, in clear and accurate language; and the remarks on hygiene form, probably, the best part of the book. But, as far as its physiology is concerned, the book bears evidence of having been written by one not thoroughly conversant with the subject.

A treatise on physiology and hygiene. By Joseph C. Hutchison, M.D., LL.D. New York, *Clark & Maynard*, 1884. Illustr. 8°.

The essentials of anatomy, physiology, and hygiene. By Roger S. Tracy, M.D. New York, *Appleton*, 1884. Illustr. 8°.

A TEXT-BOOK OF PHYSICAL GEOLOGY.

The author of this small volume has made a step in the right direction, for the plan of his book involves the wise omission of historic geology and paleontology, — subjects into whose full meaning the beginner makes but little real progress. The book would have been further improved by the omission of much of the sec-

The student's handbook of physical geology. By A. J. Jukes-Browne. New York, *Scribner & Welford*, 1884. 12 + 514 p., illustr. 8°.

tion on lithology, not from fault to be found with the treatment of the subject, but because lithology has now become too serious a study to be treated in so compressed a form. The student who uses this book without previous acquaintance with the rock-forming minerals that are here briefly described cannot obtain from the forty-six pages given to this section the knowledge that they are intended to give; unless, indeed, there is so liberal a supplement of personal instruction as to make the text practically unnecessary. We are familiar nowadays with the reaction against the mere verbal teaching of physics and chemistry, zoölogy and botany. The same spirit of reform should exclude brief treatment of lithology from an elementary book on physical geology. And, if the student protests that he wishes to gain at least a superficial knowledge of lithology, let the teacher confidently assure him that there is no such thing, but only a superficial ignorance. Better admit full ignorance than pretend to scanty knowledge, and use the space in the book and the time that would be given to it for fuller discussion of other subjects. The open admission of the author's own lack of expertness in modern lithology, by his acceptance of a chapter on the igneous rocks from Professor Bonney, is evidence enough that the section in question should not have been inserted in a book of this title.

The rest of the work is more satisfactory, because the elements of the subjects that it professes to teach can really be learned from it. It is characteristically British in fact and example, although some illustrations are taken from other countries. Its figures are hardly so good as they should be in this day of dry-plate photographs and easy reproduction of pen-and-ink diagrams. The chapter on earthquakes needs a good revision, and a terminology might be improved that allows such expressions as 'mass or weight,' 'ridge or mesa,' using these words apparently as synonymes. But, as a whole, the book gives brief, correct, and well-arranged mention of the more salient geological facts and theories, under the headings of 'change by internal causes;' 'surface agencies, destructive and constructive;' 'petrology and physiographic geology.' The description of the effects of faulting is exceptionally full; and unconformity, overlap, and overstep receive more than the usual share of attention. Under fluviatile agencies, Powell's expression, 'base level of erosion,' is accepted as the most fitting to describe this important and commonly neglected plane of reference; and, after definition and illustration, the author pertinently adds, that it is mainly because the early advocates of river-erosion neglected to insist on the control which elevation or depression exercised on river-action, that many observers have been unable to believe that rivers have had any significant share in the excavation of their valleys. There is to our mind an unnecessary scepticism as to the subglacial origin of bowlder-clay. The small and now old glaciers, which have long ago swept their beds so clean, afford only imperfect illustration of what went on beneath the ice-sheet just after its conquest of a land covered with the waste of secular disintegration; and there is nothing inconsistent in the belief that till was accumulated at one place, while moderate-sized lake-basins were excavated at another, as Geikie and Helland have fully shown. The localities selected for illustration are so largely English, that the book would require re-making to prepare it for American schools. We wish that some of our geologists who are broadly acquainted with the country east and west might undertake the task.

A TEXT-BOOK OF MICROSCOPICAL PETROGRAPHY.

At this time, when the interest in microscopical petrography is so steadily on the increase, the need of a concise, accurate, and recent text-book on the subject is daily becoming more apparent. That such a one does not exist in English is to be much regretted; but this very fact will cause information regarding an admirable one, which has just appeared in Germany, to prove all the more acceptable to geological students. Dr. Hussak's book is short and elementary; but it contains the results, even the most recent, which have thus far been attained by the many workers in microscopical mineralogy and lithology, stated in a clear manner.

The first part treats of methods — optical, chemical, and mechanical — which are now applied to the study of rock-constituents, as well as the general morphological properties which characterize them. Part second consists of a tabular arrangement of all the rock-forming minerals, with their characteristic microscopic appearance, chemical reactions, associations, decomposition products, and all other peculiarities which might serve in their accurate diagnosis, arranged in parallel columns. This is all given in a very small space; but the copious and excellent references furnish

Anleitung zum bestimmen der gesteinbildenden mineralien. Von Dr. Eugen Hussak. Leipzig, 1885. 196 p., 103 figs. 8°.

the student with the means of following up the literature of any subject as thoroughly as he may be inclined. The figures are numerous, new, and admirably fitted to illustrate the points for which they are intended. Altogether, the book is well suited for the wants of beginners, to whom the size and abstruseness of the larger works on petrography are often discouraging; and it will doubtless find many readers in this country as well as in Europe. It would abundantly repay translating into English.

SIMON'S MANUAL OF CHEMISTRY.

This book, as the preface informs us, is intended as a guide to lectures and laboratory work for beginners in chemistry, being especially adapted for the use of pharmaceutical and medical students. It is hard to see, however, in what respects pharmaceutical or medical students need special methods of treatment in their commencement of the study of chemistry before they enter upon a study of those particular branches of the science especially necessary to them in their profession.

A peculiar feature of the book is the presence of seven colored plates, showing the variously shaded colors of the more common chemicals, and their color-reactions; such as the red of mercuric iodide, the yellow of arsenious sulphide, the shades of color produced by the action of reducing-agents on a solution of potassium dichromate, etc., — a feature which can possess little value to a laboratory student, who must necessarily become familiar with these colored substances and their reactions by personal experience. The book, however, bears the appearance of being intended for students who are to have but little laboratory work; and, indeed, with the exception of the portion treating of metals and their combinations, it cannot be considered as a really good text-book for laboratory use.

There is noticeable, moreover, throughout the book, an apparent lack of connection between fact and theory. The facts are given, but the theory is lacking. When supplemented by lectures, this defect might not be so noticeable. It is, however, a point to which the student's attention needs to be constantly called. Chemistry is more than a collection of facts: it is a living science. Facts serve as a basis upon which to build theories; and the mutual connection of fact and theory needs to be constantly indicated, as well as the methods of reasoning by which the theoretical conclusions are reached.

The book, however, possesses some admirable features. As a whole, it is well written, is systematic, and contains much that is valuable. Its main defect as an elementary text-book consists in the attempt to cover too great a variety of subjects at the expense of thoroughness. Critical examination, moreover, reveals here and there an occasional incorrect or misleading statement. Thus, on p. 358 we are told that "ptyalin, the active principle of saliva, is a ferment which has the power of converting starch into glucose," whereas it has been known for the last five years that the main product of the amylolytic action of saliva is maltose. The method for the determination of nitrogen, given on p. 241, can hardly be considered as the method generally used for this purpose, as is claimed by the author; neither can the method, given on the same page, for the determination of carbon and hydrogen "by passing dry oxygen gas over the substance heated in a glass tube," be taken as a satisfactory statement of the method generally used for making a 'combustion' in oxygen gas. Again: we are told on p. 359 that pepsin, in the presence of free hydrochloric acid, does not prevent the continued action of saliva on starch, whereas it has been plainly demonstrated within the last three years that the ferment of saliva is completely destroyed by gastric juice, and even by dilute hydrochloric acid alone.

Manual of chemistry. By W. Simon. Philadelphia, *Lea's son & Co.*, 1884. illustr. 8°.

NEW TEXT-BOOKS OF PHYSICS.

Mr. Gage states his aim to be, "to collate in this volume something of value to every teacher of physical science." The book is divided into five parts: laboratory exercises, manual of manipulation, general review of physics, test-questions, and key to solution of problems. The experiments given in the first part are mostly well enough, and some of them even of considerable ingenuity. They are, however, numbered in a minute fashion, which is likely to mislead one who reads in the announcement that there are two hundred and thirty-eight experiments. In the forty-five pages devoted to the 'manual of manipulation,' very few directions for manipulation

Physical technics, or, Teacher's manual of physical manipulation, etc. By Alfred P. Gage, A.M. Boston, *Author*, 1884. 200 p. 8°.

Problèmes de physique de mécanique, de cosmographie, de chimie. Par Edme Jacquier. Paris, *Gauthier-Villars*, 1884. 6 + 271 p. 8°.

are given, and these few are not all that could be desired. This 'manual of manipulation' is mostly given up to the discussion of such topics as 'units of mass and force,' 'inertia,' 'corpuscular theory of heat,' 'what is electricity?' etc., closing with several pages of 'odds and ends.' In short, this part is any thing but a manual of manipulation: it is rather a dumping-ground for the disconnected contents of one of the author's note-books. The test-questions and solutions to problems in the author's 'Elements of physics' fill the remainder of the little volume, and will, without doubt, be of value to those teachers who use his earlier book.

The book will prove a disappointment to most teachers. It is really a supplement to Mr. Gage's 'Physics,' but the matter which it contains should have been reserved for use in the preparation of a second edition of that work.

The 'Problèmes de physique' of Jacquier is too meagre for a text-book, too full for a mere collection of problems. It is probably intended to supplement a course of lectures. The reader who is familiar with the ordinary elementary text-books of physics will find little really new or inspiring here, but rather the old, more or less satisfactory demonstrations, without the calculus, of the laws of centrifugal force, the simple pendulum, the flow of liquids from an orifice, the foci of lenses, etc., presented as the solutions of problems. The ordinary student would find this very tedious. The part devoted to heat, with its uncompromising applications of 'binômes de dilatation,' etc., would be salutary exercise, perhaps; but it reminds one of the 'school of the soldier.' We can imagine no one but an enlisted man going through it. Of course, it would be unfair to imply that the author has in no point improved upon the work of other makers of elementary books. His second proof of the law of centrifugal force almost avoids the familiar assumption that unequal things are equal; and his page devoted to showing how the one fluid theory accounts for electric attractions and repulsions would be new and interesting to many readers.

The book concludes with a collection of a hundred and seventy-one 'problems for solution,' given without answers. These, with the exception of seventeen which deal with chemical equivalents, are of about the same character as the problems in the last edition of Everett's 'Deschanel,' and will possibly be welcomed by the weary makers of examination-papers.

NOTES AND NEWS.

MR. ALEXANDER AGASSIZ'S resignation of his position as a fellow of Harvard college was naturally accepted by the corporation with great reluctance. The *Bulletin* of the university just published contains the formal votes taken at the meeting of Oct. 24, which state "that the wide range of his sympathies and interests, the confidence and affection which he inspired, and the varied information which he possessed both as a man of business and as a man of science, made his services as a fellow of singular value to the university; that his great gifts within the past thirteen years to the scientific departments, and especially to the Museum of comparative zoölogy, which amount to more than half a million of dollars, make him one of the chief benefactors of the university, and entitle him to its profound gratitude."

— The *Harvard university bulletin* for January contains a further instalment of Mr. Winsor's collation of the Kohl collection of early American maps, and the beginning (267 numbers) of another of Mr. Bliss's valuable indexes to map literature, in which the various publications of the London geographical society, together with the two principal London geographical journals, — *Ocean highways* and the *Geographical magazine*, — are treated in the same manner as he formerly indexed *Petermann's mittheilungen.* It will prove exceedingly convenient.

— The Ottawa field-naturalists' club makes a rather remarkable showing for so young a society. It has a membership of about a hundred and fifty, and an annual fee of a dollar. It has just published the fifth number of its Transactions, a pamphlet of a hundred and fifty pages, and yet has no debt. The pamphlet contains some matter of a general interest, particularly an article by Mr. W. P. Lett on the deer of the Ottawa valley, — the moose, caribou, wapiti, and Virginia deer, — and one on phosphates by Dr. G. M. Dawson.

— A course of twelve lectures on geology will be given on Thursday afternoons during February, March, and April, beginning Feb. 12, by Prof. Daniel S. Martin, at No. 58 West Fifty-fifth Street, New York. These lectures are designed especially, though not exclusively, for ladies, and are held in the building occupied by Rutgers female college.

— The Saturday lectures during February and March, under the auspices of the anthropological and biological societies of Washington, will consist of the following: Professor John Fiske, Results in England of the surrender of Cornwallis; Dr. George M. Sternberg, U.S.A., Germs and germicides; the Hon. Eugene Schuyler, The machinery of our foreign service; Mr. William T. Hornaday, Natural history and people of Borneo; Mr. Charles D. Walcott, Searching for the first forms of life; President E. M. Gallaudet, The language of signs, and the combined method of instructing deaf-mutes.

— The *Records* of the Geological survey of India, vol. xvii. part iv., contains a paper on Mr. H. B. Foote's work at the Bilba Surgam caves, in which the

existence of man in a low stage of civilization was ascertained by the discovery of a "well-made bone-gouge, and of two pieces of stag-horn, which have been cut with some sharp instrument."

— Hegnette, in the *Bulletin technologique des écoles nationales des arts et métiers*, describes a new ceramic product from the waste sands of glass-factories, which often accumulate in immense quantities, so as to occasion great embarrassment. The sand is subjected to an immense hydraulic pressure, and then baked in furnaces at a high temperature, so as to produce blocks of various forms and dimensions, of a uniform white color, which are composed of almost pure silex. The crushing-load is from three hundred and seventy to four hundred and fifty kilometres per square centimetre. The bricks, when plunged in chlorhydric and sulphuric acids, show no trace of alteration. The product has remarkable solidity and tenacity; it is not affected by the heaviest frosts or by the action of sun or rain; it resists very high temperatures, provided no flux is present; it is very light, its specific gravity being only 1.5; it is of a fine white color, which will make it sought after for many architectural effects in combination with brick or stone of other colors.

— The Royal academy of sciences of Turin gives notice that the fifth Bressa prize will be given to the scientific author or inventor, whatever be his nationality, who during the years 1883–86, according to the judgment of the academy, shall have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics. The term will be closed at the end of December, 1886. The value of the prize amounts to twelve thousand Italian lire. The prize will in no case be given to any of the national members of the academy of Turin, resident or non-resident.

— We regret to announce the death of Dr. J. Gwyn Jeffreys of Kensington, Eng., well known for his conchological researches. He died suddenly on the 24th ult. We hope in a future number to give some account of his scientific work.

— Dr. Ch. Amat has devoted some study to the Beni M'zab, — a Berber people whose territory was definitely annexed by France about two years ago, and who are described as active, sober, provident, economical, and intelligent. He remarks that the position of woman was higher among them before the introduction of Islamism. Their cemeteries, containing tombs of large worked stones, with a line of pots, plates, ostrich eggs, etc., about them, are referred to as survivals from the funeral feasts of the ancient religion. These people occupy seven towns, having a population of over thirty thousand, and are engaged in commerce.

— Capt. Poldrugo of the Austrian bark Filadelfia, from Cape Town to New York, reports an earthquake at midnight of Jan. 2, extending in an easterly and westerly direction. At the same time, he saw a large white spot on the water. He was in latitude 1° 10′ north, longitude 24° west, at the time.

— Vol. vii. No. 2, of the *American journal of mathematics*, has just appeared, and contains the following articles: 'A memoir on the Abelian and theta functions,' by Professor Cayley (this is the continuation of Professor Cayley's great memoir, the first three chapters of which appeared in vol. v. of the journal; the present article contains chapters iv.–vii., and treats principally of the case where the 'fixed curve' is a quartic both in the plane and in space); 'Solution of solvable irreducible quintic equations without the aid of a resolvent sextic,' by George Paxton Young of University college, Toronto (Professor Young assumes Jerrard's trinomial form for the quintic, finds the criterion of its solvability, and finally solves the equation in all the possible cases); a note on Maclaurin's theorem, by Hermite; the first part of a memoir on the algebra of logic, by Mr. C. S. Peirce, in which the author studies the philosophy of notation.

— No. 5 of the Izviestiya of the Russian geographical society, contains, among other things, Uspenske's account of the Island of Hainan, obtained from Chinese sources; Iwanow's report of his ascent of the Elbrus; Istomin's ethnographical journey to Archangel, and a long paper by Werestchagin on the Wotjäks. Though this Finnish people has been often discussed and described, the author gives much new and valuable information, especially in regard to mythology, feasts, and folk-lore. The closing number of vol. xii. of the Zapiski contains a long article on Korea by Otano Kigoro.

— We observe this note in a late number of the *Athenaeum:* "'PARALLAX' is dead! Dr. Samuel Rowbotham used this name as the author of 'Zetetic astronomy,' and he was well known by it as a lecturer on such subjects as 'the earth not a globe.' The doctor, some years before his death, directed his 'seeking philosophy' to chemistry; but we never heard of any discovery resulting from his search."

— The supplement to the *Berliner astronomisches jahrbuch* for 1887, containing the elements and ephemerides of the small planets for the present year, is already issued, preceding, as usual, the publication of the body of the work. The best obtainable elements of the orbits of two hundred and thirty-seven of these planets are given (two hundred and forty-four was the total number known at the beginning of 1885), as also approximate ephemerides of the same, the positions being given at twenty-day intervals. Accurate ephemerides are now computed by the *Rechnungs-bureau*, and published for only nineteen small planets.

— The 'Nautical almanac' office, Washington, has lately issued a new publication; that prepared for the present year being the first, and entitled 'The Pacific coaster's nautical almanac.' It is the counterpart of the 'Atlantic coaster's almanac,' issued for the first time in 1884, and gives, in addition to astronomico-nautical data, the times of high water at San Francisco, San Diego, Astoria, and Port Townsend, in

Pacific standard time, sunrise and sunset at San Francisco, and lists of lighthouses, lighted beacons, and floating lights, on the west coast of North and South America, including the North and South Pacific islands.

—"Geonomy: creation of the continents by the ocean-currents, by J. S. Grimes (Philadelphia, 1885)," is a book characterized by implications of blindness and conservatism on the part of most physical geographers, by assertions of the great value and originality of the author's earlier works, by a broad ignorance of what others have done, and by utterly impossible physical theories. "The reason why scienticians have neglected to investigate the laws of the currents thoroughly, and to discover the truth concerning them, is that they have not regarded them as of much importance. Had they suspected that the currents, by their operations, created the continents, they would long since have wrung from them all their secrets" (p. 49).

—Professor Charles Denison of Denver has prepared a series of climatic charts of the United States on the basis of the U. S. signal-service records, giving especial care to the illustration of elements of humidity and cloudiness. The dryer and moister regions of the country are thus clearly separated in a general way, as far as the scattered stations of observation will allow. The need of additional data in the west is sufficiently shown by noticing that Pike's Peak alone, of all its compeers in the mountains, is represented as having its conditions of humidity affected by its elevation. When the Cordilleras are correctly known, the broad colors now admitted will be broken up into very small patchwork. The maps are published by Rand, McNally, & Co., Chicago, and are interesting as being among the first attempts to bring the results of the signal-service records into popular use.

— *Science et nature* describes an electric lamp to be used with the microscope. All microscopists know how difficult it is to obtain good, clear light when working with high-power lenses, and any invention which will tend to lessen or overcome this difficulty will be appreciated by them. For micro-photography, Stearn's lights, illustrated in fig. 1, are decidedly the best. They measure about three centimetres in diameter, but may be made smaller. In fig. 2 there are three lights attached to a binocular, — one above the stage, for illuminating opaque objects; another below, to take the place of the reflector; and a third, much brighter, beneath all, to be used in photography. Each one can be regulated at will. It is not necessary, however, to have a microscope thus modified, for something like fig. 3 can be substituted. In this way one light can be made to serve the purposes of all. Dr. T. Stein describes in the *Zeitschrift für mikroskopie* a similar but less perfect arrangement. There is one important addition, however. In the stage beneath the object there is a spiral of platinum, which becomes heated when the current is allowed to pass through it, — an extremely convenient way of heating an object beneath the microscope.

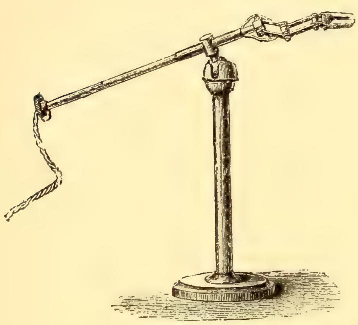


Fig. 3.

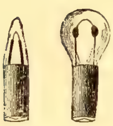


Fig. 1.

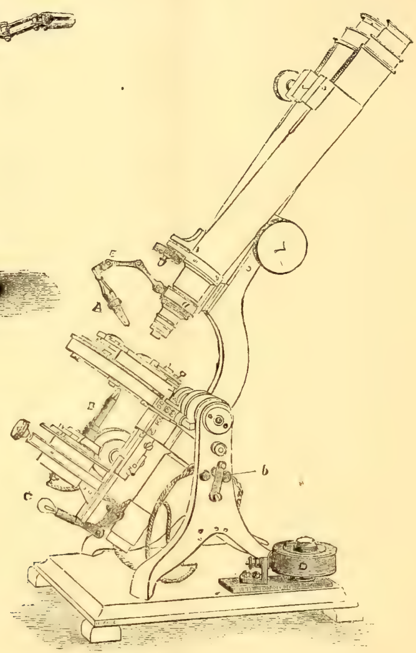


Fig. 2.

AN ELECTRIC LIGHT FOR USE WITH A MICROSCOPE.

— The geographical society of Paris awards its prizes as follows: a gold medal to Mr. de Foucauld, for his expedition to the south of Morocco, and his studies on the western extremity of the Atlas chain; a gold medal to Dr. Neis, for his four voyages to Indo-China and into the unexplored parts of Laos; the Roquette prize to the Danish periodical, *Meddelser om Groenland*, for geological and geographical researches in Greenland; the Jomard prize to Mr. Léroux, for his work entitled "Recueil de voyages et de documents pour servir à l'histoire de la géographie, depuis le xiii^{e} siècle jusqu'à la fin du xvi^{e}," published under the direction of Messrs. Scheffer, member of the institute, and Henri Cordier; the Ehrard prize to Mr. Dumas Vorzet for his charts and cartographic work.

—Mr. H. H. Johnston intends shortly to publish two works, — one on his recent experiences in eastern Africa, and the other a carefully prepared account of the Portuguese colonies of West Africa. The latter book he has had in hand since his return from the Kongo. Mr. Johnston's studies and sketches of Mount Kilimanjaro will appear shortly in the *Graphic*.

SCIENCE.

FRIDAY, FEBRUARY 20, 1885.

COMMENT AND CRITICISM.

We are glad to learn that the Bureau of scientific information of the Philadelphia academy of natural sciences, the organization of which was briefly noticed in these columns last autumn, is already in successful operation. It is no small sacrifice upon their part when a score or more of busy specialists volunteer to receive and answer, without charge, reasonable inquiries in their several departments. It should be remembered, that while many persons are well enough informed to know to whom to write, and are courageous enough to do it, others, from the want of such information, from modesty, from fear of trespassing upon the time of those to whom they would gladly write, or from anxiety lest their request might meet with inhospitality and rebuff, are led, in fact, to refrain from questioning, and become eventually contented with ignorance, or, worse yet, half-knowledge. To mention but a single one of the many excellent features of this scheme, viz., bibliography, we need not say what a boon it will certainly be to some one, far removed from monographs, to feel free to consult Dr. Nolan, librarian of the academy, assured beforehand of his cordial co-operation.

We are pleased to note that the views regarding the proper functions of agricultural experiment-stations, which have been advanced in recent numbers of *Science*, have found independent expression in a report to the regents of the University of Nebraska by Prof. C. E. Bessey, dean of the industrial college. His report includes a plan for experimental work in agriculture, horticulture, and entomology; which plan, we are informed, has been adopted by the regents. It provides for two classes of experiments, designated as 'popular' and 'scientific;' the first designed to reach immediate results, and the second to establish general principles. Professor Bessey does not fail to attach due value to 'popular' experiments, but he points out two facts which seem to be frequently forgotten by those who make such experiments.

The first is, that while such experiments may often be of great immediate value, they are usually so only within narrow limits of both space and time, while a scientific principle, if once actually established, is true at all times and under all conditions. The second fact is, that many experiments of this character are constantly being made by private enterprise in all parts of the country. This is particularly the case with tests of new varieties of plants and new patterns of machines. Scientific experiments, on the other hand, demand special training and apparatus, such as private enterprise does not usually command; and it is therefore especially important that experiment-stations and colleges which have the facilities for such experiments should be encouraged and supported in undertaking them to as great an extent as may appear practicable in each particular case.

The knowledge of thunder-storms is advancing at a good pace. France has made special study of them for a number of years; Bavaria and Belgium have more recently taken them up; and last summer they were made the subject of special investigation by our signal-service, with the aid of a large corps of voluntary observers, that is to be continued during the coming season. A recent report by Lancaster, on the storms of 1879 in Belgium, confirms the conclusions previously announced there, and discovered to obtain so clearly in this country, that thunder-storms occur only in the south-east quadrant of the barometric depressions, or great cyclonic storms that frequently sweep across temperate latitudes.

But there still remains to be found the actual mechanism of thunder-storms, concerning which various more or less theoretical opinions have been published. The matter will probably remain in doubt until settled by the same kind of investigation that demonstrated the inward spiral path of cyclonic winds. Synoptic charts for a stormy afternoon, with hourly or even half-hourly intervals, and stations only a mile or two apart, would probably settle the question beyond dispute; and the first local weather service that succeeds in preparing a set of such charts will gain a prize worth working for.

LETTERS TO THE EDITOR.

⁂ *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The incandescent light on steamers.

The instance cited in No. 104 of *Science*, of early electric lighting of steamboats by the incandescent system, though earlier than that given by Professor Trowbridge, is not the earliest.

I crossed the Atlantic in May, 1882, in the steamer City of Richmond, of the Inman line, which was beautifully lighted by the incandescent system. It is my impression that the lamps were of an English make, the form of the carbon filament being somewhat different from that then used by Edison and other Americans. C. H. Ames.

Chopping-stones.

It is not improbable that the implement figured in a recent article by Miss Babbitt (iv. 529, fig. 3) could have been used as a fuel-breaker, when fastened in a wooden and hide handle; but a more evident use for such notched pebbles, namely, as net-weights, is seen in an industry of the present day among the gill-net fishers, both Indian and white, of the Great Lakes. Net-weights of this character are produced in large quantities at all points on the lakes where gill-netting is in vogue, forming frequently a part of the ballast in the bottoms of the 'Mackinaw' fishing-boats, and lying conspicuously scattered over the sand and beach in the neighborhood of fishing-stations. A less primitive appliance for sinking the nets is coming into use; so that the notched discoidal pebbles, attached to the net with short pieces of twine, are now regarded as old-fashioned by the more thrifty fishermen. The unnotched pebble net-weights, bound with bark, of the Red-Lakers, are interesting as a still more primitive form; but more extended observation in gill-net appliances would have shown Miss Babbitt that the notched form is of far more usual occurrence than she leads us to suppose, and that it possesses tons of examples on the shores of the Great Lakes.

I have found such implements associated with the remains of recent Indians (chert chippings, broken pottery, etc.) in the sand-dunes at Evanston. The modern net-weights are distinguishable from those of the chert deposits in only one particular, that while the surfaces of the former are smooth, and their notches rough and angular, those of the latter show on their surfaces the effects of disintegration from long exposure on the sand to atmospheric agencies, their notches, too, having assumed the same crumbling character as the rest of the pebble. A large number of them (over twelve) which came to my notice at one place indicates their use as net-weights rather than as 'chopping-stones.' W. A. Phillips.

Evanston, Ill.

The use of slips in scientific correspondence.

I have been interested in Mr. Mann's and other articles on filing scientific notes.

Any one wishing to file such notes will find that a very convenient method of doing so is by the use of the Shannon file, which may be found at any large stationery store. The punch for punching the holes through the paper is the most convenient I have seen, as the holes are always the same distance apart, and at the same distance from the edge.

S. P. Sharples.

The decadence of science about Boston.

In a late issue (No. 104), *Science* comments upon the decadence of science about Boston. Is it not an explanation of this decadence that more and more in late years the mental atmosphere of Boston has become one of intellectual finish, rather than of intellectual earnestness? Of course, each of these traits has its excellences, as each may be exaggerated; but the latter of the two certainly is far more favorable to the active growth of science in a community. Moreover, the effect of an intellectual atmosphere becomes most evident when it has begun to influence the lives of young men grown up in its midst, and who take their cue in life from it. Is not this effect to be noticed in the present case? X. C.

Koch's 'comma bacillus.'

In the reproduction of the drawing of the 'comma bacillus,' made to illustrate my paper in *Science* for Feb. 6, some defects are noticeable, to which it seems necessary to call attention, inasmuch as the design was to represent as accurately as possible the morphology of this much-talked-of micro-organism. The ends of some of the commas in the figure seem to be cut off square, whereas in the slide and in the drawing they are all rounded. Since writing the paper referred to, I have been favored by Dr. Koch with a slide of the 'comma bacillus,' in which the long spiral forms are far more numerous than in the slide sent to the Army medical museum, from which the drawing was made. Several of these spiral filaments are often seen in a single field, and many of them are longer than that seen in the centre of fig. 1.

Geo. M. Sternberg, *surgeon U.S.A.*

Johns Hopkins university, Baltimore,
Feb. 11.

Carnivorous habits of the muskrat.

My observations of these animals were conducted principally along the banks of the Alleghany River in the vicinity of Warren, Penn., where these enemies of fresh-water bivalves are very numerous.

1°. The muskrat opens the shell by first severing the posterior adductor muscle. This can readily be accomplished, as the animal seldom immediately empties the branchial chamber after capture, but remains with the valves slightly gaping, with the siphons open, until it receives quite severe handling, upon which the water in the branchial chamber is violently ejected. The valves will also partially open if the

shell is allowed to remain untouched for some time, as if the animal was trying to acquaint itself with its new surroundings. After one adductor is severed, the valves open, so that the other may be easily reached.

2°. I have often seen the posterior margins of the valves slightly notched, and the epidermis scratched, from the efforts of the muskrat to open the shell.

3°. The shells are never opened by tearing away the hinge-ligament, although this portion is sometimes injured.

4°. During the winter season the shells were deposited, often many bushels, upon the edge of the ice which fringed the shores. This offered an explanation to me for the large quantities of dead shells which I had frequently noticed in certain localities at the bottom of the river.

5°. With the mussels in the muskrat shell-heaps were many flat stones, gathered for the purpose of eating the algae growing upon them.

6°. Among the species eaten by the muskrats of the Alleghany River may be mentioned the following as of the most frequent occurrence: Unio ligamentinus, U. phaseolus, U. gracilis, U. patulus, U. clavus, U. crassidens, U. occidens, U. ovatus, U. luteolus, U. gibbosus, Margaritana rugosa, M. marginata, and Anodonta edentula.

Chas. E. Beecher.

Albany, N.Y., Feb. 9.

I have been familiar, ever since my boyhood, with the fact that these animals live largely upon the mussels and other shell-fish of our rivers and creeks. It is also well known to duck-hunters, at least in this region of country, that they pick up no inconsiderable portion of their subsistence from dead and wounded birds found by them after the sportsman has abandoned the search. Only last spring I killed a duck in this vicinity which fell out of reach and floated off. Upon recovering it within less than an hour afterwards, on the farther shore of the 'slough,' its breast had already been eaten away by a muskrat; and it is no uncommon occurrence to surprise them at such repasts.

Theo. S. Case.

Kansas City, Mo., Feb. 9.

If those interested in the carnivorous habits of the muskrat will refer to *Science*, No. 62, they will find there a notice of a discussion upon this subject, which took place before the Biological society of Washington in the spring of 1884. In regard to the fact that piles of *unbroken* Unio shells are found near muskrat burrows, it seems to me that there can be but one explanation, and that is the suggestion made at the Biological society, that the shells are gathered by the muskrats, piled up, and left out of water until too weak to keep their shells closed, when the rodent finds it an easy matter to pick out the meat.

Ralph S. Tarr.

Cambridge, Mass., Feb. 6.

JOHN GWYN JEFFREYS.

The ranks of English naturalists have met with a serious loss in the death of John Gwyn Jeffreys, LL.D., F.R.S., etc., which took place suddenly at his residence, Kensington, on the 24th of January.

Dr. Jeffreys was born at Swansea, Jan. 18, 1809, and at the time of his death, with the exception of Sir Richard Owen, was probably the oldest British naturalist. Up to the last he was busily engaged on the investigation of the deep-sea dredgings of the Lightning and Porcupine expeditions; and, only three days before the reception of the news of his death, a copy of a recent paper on the relations of the American and European mollusk faunae was received from him.

Dr. Jeffreys was the descendant of one of the oldest families of Wales, and was called to the bar at Lincoln's Inn. For many years, however, he had retired from practice, and had been devoted to the investigation of the natural history of mollusks, especially those of the British islands, northern Europe, and the adjacent seas. His work on the British mollusca is the standard book of reference on that topic, and his investigations into the fauna of the deep sea were known and appreciated among men of science everywhere.

Dr. Jeffreys, from a lad, had been a student of conchology, devoting his holidays to collecting, and was among the earliest, most energetic, and persistent dredgers of the British seas. In his earlier days he was intimately acquainted with that classical band of British naturalists to whom science owes so much, and who toiled for the most part unappreciated. In later years he was equally active, and participated in the important expeditions of the Lightning, Porcupine, Valorous, etc., and was only prevented by an accident from participation in the voyage of the Challenger. His first important paper was published by the Linnean society in 1828; and since then hardly a year has passed by without contributions from his pen, many of which were printed by the Royal society, of which he was for forty-five years a fellow. The extent and importance of his researches can only be fully appreciated by specialists engaged in similar studies. He was president of the biological section of the British association in

1877, and held the office of high sheriff of Hertfordshire and other important public trusts at various times. He was treasurer of the Geological society for many years, and honorary or corresponding member of many foreign societies.

In scientific matters, Dr. Jeffreys had something of the conservatism natural to a person of his years; but his opinions, however firmly held, were never expressed with bitterness, and his geniality and hospitality bound to him in friendly ties not only scientific men, young and old, but the intelligent and cultured throughout his wide circle of acquaintance. He leaves a son, Mr. Howel Jeffreys, and five daughters, one the wife of Prof. H. N. Moseley of the Challenger expedition. His collection, which for British seas is absolutely unrivalled, possessing many of the actual types of Turton, Alder, and other early British naturalists, and an extremely rich and largely unique North Atlantic and North European series will form one of the treasures of the National museum at Washington, where a portion of it has already been received. W. H. DALL.

THE WASHINGTON NATIONAL MONUMENT.

THE history of the undertaking which has resulted in the completion of the Washington monument presents a number of interesting and curious facts; and the construction of the monument itself, by reason of the magnitude of the structure, has involved some problems of considerable engineering importance.

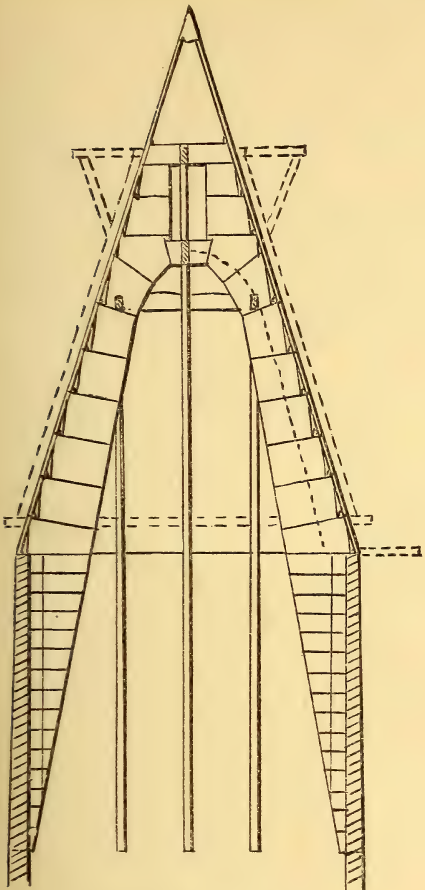
The early history of the monument may be said to date from 1783, when congress resolved to erect, wherever the residence of congress should be established, an equestrian statue of Washington; and in 1795, when it was proposed to build a monument commemorating the American revolution, Major L'Enfant, the designer of the plan by which the city of Washington is laid out, selected, and Gen. Washington himself approved, the site where the finished monument of which we write now stands.

After the failure of these and other similar plans, the next step was taken in 1833, when, under the auspices of the Washington national monument society, the aid of the people of the United States was invoked to raise the sum required to erect a great national monument, no one to contribute more than one dollar, — a restriction which was removed in 1845. Money came in slowly; but by 1847, $87,000 had been raised, and it was determined to make a beginning; and, by authority from congress, President Polk deeded the present site to the society. Building was at once commenced, but proceeded slowly; and in 1854 the society had spent $230,000, and raised the monument to a height of 152 feet above the base.

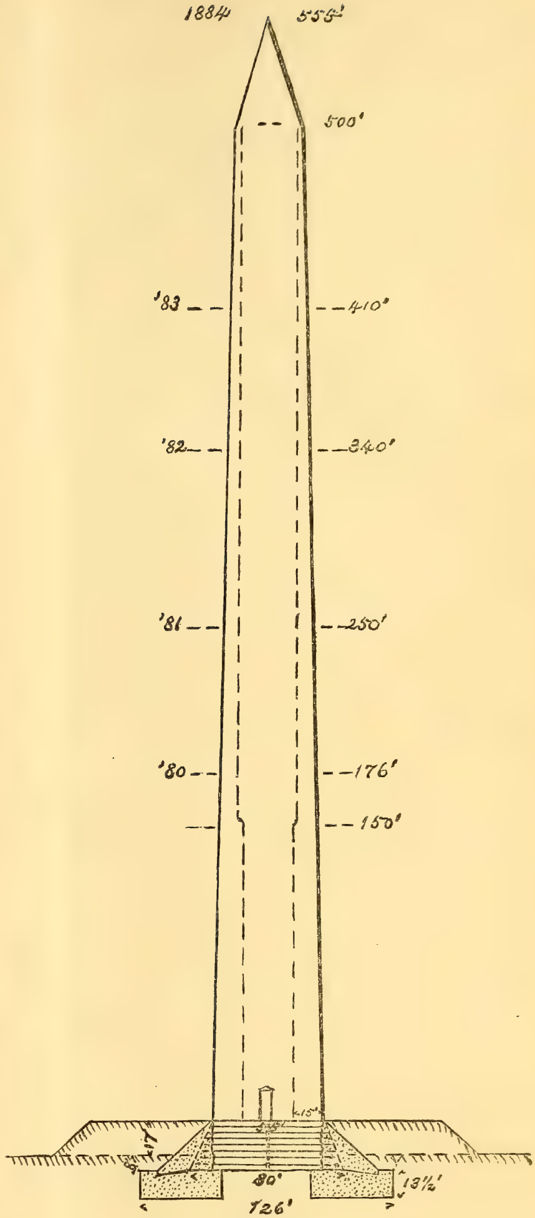
The original design by Robert Mills included an obelisk faced with white marble, 600 feet high, 55 feet square at the base, and 30 feet square at the top, surrounded at its base by a circular rotunda or colonnade 250 feet in diameter and 100 feet high, in which were to be placed statues of the nation's illustrious dead, with vaults beneath for the reception of their remains.

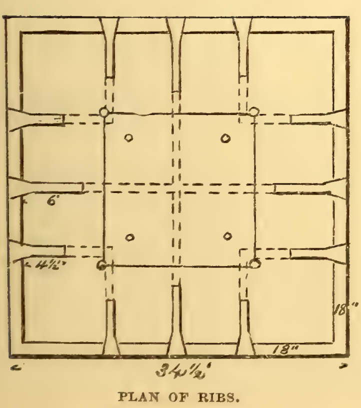
The base or foundation masonry was about 80 feet square at the bottom, laid at a depth of but eight feet below the surface of the ground, and carried up, in steps of about three feet rise, to a height of 25 feet, where it is 58 feet square. The slight depth to which the foundation was carried was due to the anxiety of the building committee to have something to show for the money expended. It was built of rubble masonry of blue gneiss, the blocks large and of somewhat irregular shapes (nearly as they came from the quarry), laid in a mortar of hydraulic cement and stone lime, the joints and crevices filled and grouted. The shaft of the obelisk was built hollow, with walls 15 feet thick at the base; the well, or hollow interior, being 25 feet square for the whole height then built. The exterior face, to an average depth of sixteen or seventeen inches, was of Maryland marble, usually called alum-stone. The remaining thickness of the walls was of blue-stone rubble backing, not the best construction for a building of such enormous weight.

To ascertain the kind of earth that would be under the monument, a well was dug, some 25 feet deep, in the immediate vicinity of the site, and the earth particularly examined. The material was found very compact, requiring a pick to break it up, and was pronounced suitable for a structure of the kind. At a depth of twenty feet a solid bed of gravel was reached, and, six feet lower, water was struck. Before the first course of marble was laid, bench-marks were located from which to test the settlement of the monument. After building to 126 feet in height above the ground, the chairman of the building committee writes,

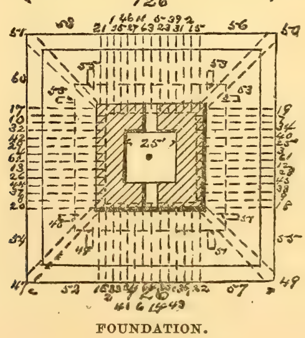


SECTION THROUGH APEX.





PLAN OF RIBS.



FOUNDATION.
126′

in 1853, 'There is no perceptible settlement' of the base, — a statement which seems hardly accurate, judging from what is usual, and from what appeared later. Here may be mentioned, as of interest later, that the architect, Mr. Mills, in 1848, levelled from the top of the third course or step of the foundation to a point on top of the meridian-stone monument near tide-water, planted by President Jefferson, and thus established a reference by which he might detect any settlement occurring in the progress of the work.

On Feb. 22, 1855, congress having been petitioned for aid, a committee of the house approved of the work done, and recommended an appropriation of $200,000. But this was the period of the Know-nothing excitement; and, on the very day that the appropriation was recommended, the books and papers of the monument society were forcibly seized by adherents of the American party, and a new board was illegally formed from their members. This action again delayed progress, and, during their rule of four years, only four feet were added, bringing the obelisk to the height of 156 feet above the base, at which elevation it long rested. On Feb. 22, 1859, this board was ousted by the incorporation by congress of a new Washington monument society for the purpose of finishing the work. These changes probably account for the more or less complete disappearance of the original plans, measurements, bench-marks, etc., which is afterwards noted. The civil war soon followed, and no actual work was done for many years. The society remained as custodian during this time, and made some attempts to re-awaken public interest. Numerous examinations were made by government officials of the condition of the stone work, which in some places was slightly chipped at the edges by flush jointing, and of the foundation. In April, 1874, Lieut. Marshall found that the axis of the shaft was inclined 1.4 inches to the north-west. At one time it was hoped that the bare shaft might be finished in some form by July 4, 1876; but the unsatisfactory condition of the foundation prevented.

All hope of completing the monument by the centennial anniversary having gone, the matter apparently rested until August, 1876, when an act of congress was approved, providing that there should be appropriated $200,000 in four annual instalments, to continue construction; the officers of the society being required to transfer the property to the United States, and the construction of the monument to be under the direction of the president of the United States, the supervising architects of the treasury and of the capitol, the chief of engineers, and the first vice-president of the monument society. In the examination called for in this act, it was very curiously discovered, by levels taken to what was then supposed to be the meridian-stone previously referred to, that the monument had, in twenty-eight years, settled nearly nine inches into the ground. A lively investigation by those most interested presently developed the fact that Gen. Babcock, when in charge of buildings and grounds in Washington, had, in the course of improvements, graded off and carted away the meridian-stone monument; so that, added to the loss of all plans and details, we must now relinquish all hope of knowing whether the monument had settled or not.

Congress then authorized the re-enforcing of the foundation; and the work was placed in charge of Lieut.-Col. Thomas Lincoln Casey, U.S. engineers, who had devised, and has successfully carried out, the plan shown in the sketch. The earth about the base, some 10,000 cubic yards, was first removed. Then a trench 4 feet wide, 13.5 feet deep, extending 23 feet outside of the old foundation, and tunnelling 18 feet under it, was excavated. The trench was then filled with concrete of four parts broken stone, three parts pebbles, two parts sand, and one part Portland cement, mixed by machinery in a cubical box rotating on a diagonal axis, and then thoroughly rammed in place. When the space under the old foundation was as nearly filled as convenient, more concrete was put into small gunny-sacks, and rammed home horizontally, while yet soft, with a heavy timber. The order in which these trenches were made and filled is numbered on the plan. At first it was intended to make and fill two opposite trenches at the same time; but it was found that removing 144 square feet of the foundation (only 2.5 %) caused a too rapid motion of the column, and, after the first four trenches, but one trench was made and filled at a time. This sensitiveness of the obelisk to disturbance appears to confirm the opinion that the old foundation was already carrying nearly the maximum allowable load.

The effect of cutting these trenches was studied by means of a plumb-line suspended from the top of the shaft, and hanging freely through a graduated metal circle near the floor. The greatest movement at the beginning of the work was $\frac{11}{24}$ of an inch. By careful watching and working, the original deflection of 1.75 inches was almost entirely

corrected. The area of the foundation was increased 150 %, or from 6,400 square feet to 16,000 square feet, and was carried down to 21.5 feet below the original surface of the ground. Careful levels showed, that, during the process of underpinning, the base of the monument settled two inches.

The foundation was further strengthened, and the pressure distributed over the whole of the new base, by placing a continuous buttress of concrete around the base, from the top of the old foundation halfway out on the concrete base; a portion of the foundation masonry being cut away, as shown in the sketch, to give a good bearing. A terrace of earth was afterwards added, to cover the rough masonry, and to still further increase the depth to which the foundation was carried, and thus to increase the resisting-power of the ground against lateral displacement.

The new foundation was completed in May, 1880; and on Aug. 7 President Hayes assisted in laying the first new stone on the shaft. On the new portion the space inside was enlarged from 25 feet square to 31.5 feet square, to diminish the weight by lessening the thickness of the walls; and solid granite backing, in two-feet courses to correspond with the outside marble courses, was substituted for the irregular rubble-work. When the wall grew considerably thinner, marble was used throughout. The thickness at 500 feet is 18 inches. The monument rose 26 feet in 1880, 74 feet in 1881, 90 feet in 1882, 70 feet in 1883, and 90 feet, to which was added the apex of 55 feet, in 1884.

Eight iron columns rise in the interior, shown by small circles on the plan of the top. Four of them are far enough from the wall to support the iron platforms and stairways by which the monument may be ascended: the other four act as guides for an elevator. These columns have been connected with the water-bearing stratum below the monument, and with the metallic point on the apex.

Several ways of capping the monument, or of constructing the apex to suit its exposed position, and secure permanence, were discussed. The adopted design was by Bernard R. Green, civil engineer. Three stone corbels, one foot thick at the edge, begin to grow out from each side of the well within the monument, at a point thirty feet below the top of the wall. They increase in width as they ascend, until at the top of the wall the middle one projects six feet, and the side ones four feet and one-half each. From them spring stone arched ribs, which in turn support the roof-covering of stone slabs seven inches thick. The middle ribs rise thirty feet, and intersect on a cross-shaped keystone; the side ribs abut against one another, and a square stone frame some seven feet lower down. The apex is terminated by an aluminium point.

After the main walls had reached their ultimate height, a frame carrying a derrick mast, which reached to a height of 75 feet, was erected on the tops of the iron columns. An opening was left in the lower roof-course at one side; the stone for the roof run out on a small balcony supported by projecting beams, and then raised to place. When all but three roof-courses were set (in all, some 14 feet in height), a platform was built around the top, supported on brackets resting on the slanting sides of the roof, and carried, in turn, on beams projecting through the apertures for observation left in the lower part of the roof, two on each side; and the nine remaining stones were distributed on this platform. The central derrick was then removed, and a small quadruped derrick erected on the platform and over the point of the roof. Thus these stones, including a cap-stone weighing 3,300 pounds, were readily set, and the apex completed Dec. 6, 1884. A small opening near the top, afterwards closed by a stone slab, permitted the retreat of the workmen who removed the scaffolding.

Since the completion of the foundation, and the resumption of building the shaft, some slight settlement has taken place, increasing regularly and uniformly with each addition of a few courses of stone. After a few weeks from any suspension of building, settlement has always ceased; and hardly a perceptible movement again occurred until after some 200 tons' weight had been added, when the same process of settling was repeated. Altogether, in the addition of 400 feet in height, and about 34,000 gross tons, 12,000 tons of which are in the earth terrace over the foundation, the settlement was two inches. The entire settlement, due to underpinning the foundation and completing the superstructure, is about four inches. The movements of the plumb-lines, of which there were two, — one from the height of 148 feet, and the other from 259 feet, — were but trifling. Changes in them were infrequent, and probably not always, if often, due to actual leaning of the shaft.

The workmen were protected against injury from falling by a strong net suspended around the outside of the shaft; and, since the resumption of construction by the United States, the only accident has been the breaking of the

arm of one of the men. The cost thus far is $1,188,000. The completed structure weighs 81,000 tons.

In this connection, some of the heights of notable structures may be of interest: Tower of Pisa, 179 feet; Bunker Hill monument, 221 feet; Great mosque, Cairo, 282 feet; Trinity spire, New York, 284 feet; Campanile, Florence, 290 feet; top of capitol, Washington, 307 feet; Milan cathedral, 355 feet; St. Paul's, London, 365 feet; Antwerp cathedral, 402 feet; Lutheran Mariankirche, Lubeck, 430 feet; St. Stephen's, Vienna, 441 feet; St. Rollox chimney, Glasgow, 450 feet; Great pyramid, 450 feet (originally 485 feet); St. Peter's, Rome, 455 feet; Strasbourg cathedral, 468 feet; Cologne cathedral, 511 feet; Philadelphia city hall, to be 535 feet; Washington monument, 555 feet.

Many memorial stones were contributed by the states, and by different organizations in this country, and by foreign countries. Some forty of these stones were set in the interior faces. One hundred still remain in the storehouse, and will probably be affixed as slabs to the interior walls in convenient places.

Charles E. Greene.

THE ELECTRIC LIGHT FOR LIGHTHOUSES AND SEARCH-LIGHTS.

The recent experiments in England (*Nature*, vol. xxx. p. 362), upon the relative merits of electric, gas, and oil lights for lighthouse illumination, have called attention to the very marked failure of the arc-light to penetrate through a misty or foggy atmosphere; this failure being due to the vigorous absorption of the blue rays of the spectrum by such an atmosphere, — rays in which the arc-light is especially rich. A very striking case of similar failure was presented to the writer's notice a few evenings ago. One of the streets of Washington has recently been lighted by arc-lights on each side, upon posts several feet higher than the gas-lamps; so that, in looking along the street, the rows of electric lights above the gas offer a good opportunity for comparison. For several nights both were lighted; and one of these nights chanced to be extremely foggy for a few hours in the evening, the ground being covered with slush from melting snow. For this reason I went out of my way to see the effect upon these lights, and was rewarded by the sight of the arc-lights — overpoweringly bright close at hand — becoming almost as faint and yellow as the gas-lamps at a distance of less than half a mile. The extent of the arc-lights was only five blocks, and the treasury building at one end, and patent office at the other, prevented a view from a greater distance; but there can be no doubt, that, if the relative rates of absorption had continued in the same ratio for a greater distance, the arc-lights would have appeared fainter than the gas-lamps at a distance of not much over half a mile, and would have entirely disappeared long before the latter. The arc-lights are said by the company to be of about two thousand candle power, and the gas-lights probably equal between fifteen and twenty candles; so that the enormous difference of absorption under these circumstances is evident at a glance. To be sure, this was a very thick fog; but this is the very condition of things where penetrating power is most necessary for lighthouse lamps, and where the arc-light seems to fail utterly.

For search-lights, in naval warfare, as protection against torpedo attack in thick weather, and for other similar purposes, the case is just as bad, or even worse; for the light must traverse the necessary distance twice, — to the dangerous object, and then reflected back to the ship. For determining the best quality of light for submarine search, experiments upon the selective absorption of sea-water for various kinds of luminous radiant energy would seem to be desirable.

Professor Langley has shown, within the last year or two, that our atmosphere absorbs much more of solar radiant energy than has been heretofore supposed, and that this is very largely in the blue end of the spectrum; so that sunlight, if we were rid of our atmosphere, would be much bluer than we see it. He has shown, too, that this takes place by diffusion of the light by reflection in all directions from particles in the atmosphere, so that we get about half our daylight from the sky, even in a perfectly clear day; and that this is the cause of the blue sky.

The same explanation is sufficient to account for all the phenomena of the wonderful red afterglows following the sunsets of a year ago, if we can explain the presence of reflecting particles in a more or less stratified arrangement (Krakatoa dust, very likely) at an unusual height in the atmosphere. These would reflect sunlight to us in much greater amount and for much longer (semi-intermittent) intervals than the ordinary dust and clouds at a lower level of the atmosphere; and this selective absorption would account for the wonder-

ful color, the light growing redder the farther it traversed the atmosphere.

In a recent article[1] Professor Langley states his belief that much of this diffusion of the blue rays, as also the general absorption of the whole spectrum, is due to fine dust-particles in the atmosphere. The very strong absorption of the blue rays of the arc-light by fog would seem to suggest the inquiry whether the average size of the minute water-drops forming this fog has any thing to do with the remarkably selective effect upon the blue wave-lengths, or whether this is simply the absorption effect of water *en masse.*

With the failure of the arc-light to penetrate fog comes the natural inquiry, whether the incandescent lamp will be any better for lighthouse and search-light purposes. Now, the part of the solar spectrum most free from atmospheric absorption-lines is in the orange, with part of the neighboring yellow and red; and some experiments have shown that this region — or the yellow part of it, at any rate — is that in which the incandescent carbon filament is especially rich, relatively more so than the solar spectrum, and it is the brightest part of that. So that there would seem to be every probability that the incandescent lamp would prove very effective in fog penetration, perhaps most efficiently so at a slightly lower temperature and brilliancy than the present average. The difficulty for lighthouse and search-light purposes would be in concentrating a sufficient amount of luminous radiating filaments in a very small space near the focus of a lens or mirror, which is a strong point in the effective use of the arc-light. With single-filament lamps this would be impossible; but the writer can see no insuperable difficulty in arranging a whole bunch or cluster of interlacing loops, joined in multiple arc within the same exhausted globe, so as to present almost a complete network of filaments over a vertical projection of an inch or two square, and yet not have them touch each other; unless, indeed, the great heat might soften the globe enough to let it collapse; and this could probably only be determined by experiment. The suggestion that a slightly lower temperature might be about as effective in fog penetration would help a little, but not very much, on account of the rapid decrease of luminosity, with slight fall in temperature. Special care would need to be taken to make each of the filaments of the cluster of equal resistance with the others; but no more so than in any set of lamps on the same circuit, and no doubt all the difficulties could be speedily surmounted. Some experiments upon the fog-penetrating power of the incandescent lamp would certainly seem to be worthy the attention of those engaged in these matters; for there can be no question about the far greater convenience, cleanliness, safety, and reliability, of the incandescent lamp over all others, even if it is not so economical. But in government lighthouses and war-ships the economy is not so important, reliability and fog-penetrating power being the prime requisites. H. M. Paul.

[1] *Philosophical magazine*, October, 1884.

RECENT DETERMINATIONS OF LONGITUDE ON THE WEST COAST OF SOUTH AMERICA.

The recent completion of the longitude measurements on the western coast of South America by the U. S. naval officers, under the command of Lieut.-Commander Charles H. Davis, U.S.N., affords a remarkable proof of the accuracy of the methods and instruments now in use for such operations. Lieut.-Commander Davis commenced his measurement in November, 1883, at Valparaiso, and terminated it in March, 1884, at Panama; connecting there with the chain of measurements made in 1875 by Lieut.-Commander F. M. Green, U.S.N., and measuring from Valparaiso to Arica, Arica to Payta, Payta to Panama,[1] and in December, 1883, with the aid of Dr. B. A. Gould, director of the Cordoba observatory, from Valparaiso to Cordoba. This work completes the telegraphic measurement of the polygon Washington–Key West, Key West–Havana, Havana–Santiago de Cuba, Santiago–Kingston, Kingston–Aspinwall, Aspinwall–Panama,[2] Panama–Payta, Payta–Arica, Arica–Valparaiso, Valparaiso–Cordoba, Cordoba–Buenos Aires, Buenos Aires–Montevideo, Montevideo–Rio de Janeiro, Rio de Janeiro–Bahia, Bahia–Pernambuco, Pernambuco–St. Vincent, St. Vincent–Madeira, Madeira–Lisbon, Lisbon–Greenwich,[3] Greenwich–Washington.[4]

This great chain of longitude measurements, consisting of twenty links, closes with but an insignificant discrepancy; the longitude of the Cordoba observatory by way of Lisbon, Rio de Janeiro, and Buenos Aires, being 4 h. 16 m. 48.06 s., and by way of Wash-

[1] Report of the U. S. coast-survey for 1875, appendix No. 11.
[2] Telegraphic longitudes in the West Indies and Central America, Washington, 1877.
[3] Telegraphic longitudes on the east coast of South America, Washington, 1880.
[4] U. S. coast-survey report for 1870.

ington, Panama, and Valparaiso, 4 h. 16 m. 48.24 s., showing a discrepancy of only 0.18 s.

These measurements have, with the exception of those joining Greenwich and Washington (made by the U. S. coast-survey) and those joining Valparaiso and Buenos Aires (made by Dr. B. A. Gould), been made by officers of the U. S. navy, and are homogeneous, each determination being the result of repeated comparisons through a telegraphic line of time-pieces whose errors on local time were ascertained on the same night by careful transit observations.

It will, of course, be understood that the remarkably small discrepancy (0.18 s.) by which this great polygon fails to close is the algebraic sum of all the errors affecting the various longitudes; but its very small amount is an indication of the care and painstaking of the officers whose labors have given this result, as well as of the accuracy of the instruments and methods employed.

In addition to his valuable work between Panama and Valparaiso, Lieut.-Commander Davis has recently determined telegraphically the longitude of Vera Cruz by measuring from Galveston, and has, on the west coast of Central America, furnished the Guatemalan boundary commission with a starting-point by fixing from Panama the longitude of Guatemala City (in co-operation with Mr. Miles Rock). A detailed report of the work of Lieut.-Commander Davis will shortly be published by the U. S. navy department.

THE KILIMANJARO EXPEDITION.

AT a meeting of the Royal geographical society, Jan. 26, Mr. H. H. Johnston gave a description of his visit to Kilimanjaro, on the slopes of which he spent more than five months in the summer and autumn of last year.

Giving a lively and picturesque narrative of his adventures during his stay with Mandara, chief of Moshi, a person of remarkable character, who rules a small tract on the lower slopes of Kilimanjaro at an altitude of about 6,000 feet, and is at war with all the surrounding potentates, Mr. Johnston told how, after some difficulties, he began the ascent of the mountain with forty carriers and some guides, provided by another chief, Maranga. As a good place for settlement close to water, and not too high up, so that his shivering followers might not suffer unreasonably from cold, he selected a grassy knoll, rising above the river of Kilema, which takes its source near the base of Kimawenzi. The altitude of this spot was nearly 10,000 feet. Having seen every one carefully installed and protected from the — to them — severe cold (for the thermometer descended every night to one or two degrees below freezing-point), he transferred his own quarters to a higher elevation, and began industriously to collect.

Abridged from *Nature*, Jan. 29.

His first excursion was to the base of Kimawenzi. The terrible hurricane of wind, however, that raged round this jagged series of lava-peaks, prevented him from continuing the ascent, although he doubted if it were possible for any one to reach the summit, owing to the want of foothold. The snow varied very much in quantity on Kimawenzi. Sometimes the whole peak would be covered down to the parent ridge, with only the precipitous rocks peeping blackly through the mantle of white. At other periods the snow would be reduced to an insignificant patch, and the reddish sand which filled the crevices and glissades between the lava-rocks would be left exposed to view. This change from an almost complete snow-cap to nearly no snow at all might be effected in twelve hours.

His great object, however, was to reach the snows, and, if possible, the summit of Kibô. To do this it would be necessary to sleep on the way. He had, therefore, to induce a few followers to accompany him to carry impedimenta. Starting at 9, he walked upwards, with few stoppages, until 1.30. At first they crossed grassy undulating hillocks, the road being fairly easy. Then they entered a heathy tract, scorched and burnt with recent bush-fires; but higher up, where the blaze had not reached, the vegetation was fairly abundant and green. Small pink gladioli studded the ground in numbers. At an altitude of nearly 13,000 feet, bees and wasps were still to be seen, and bright little sun-birds darted from bush to bush, gleaning their repast of honey. A little higher they found warm springs, the thermometer showing the temperature of the trickling mud to be 91° F. Mounting high above the rivulet, the scenery became much harsher. Vegetation only grew in dwarfed patches as they passed the altitude of 13,000 feet, and the ground was covered with bowlders more or less big, apparently lying in utter confusion, and without any definite direction. They were not very difficult to climb over, and even seemed to act as irregular stone steps upwards. In their interstices, heaths of the size of large shrubs grew with a certain luxuriance. About 13,700 feet, he saw the last resident bird, apparently a kind of stonechat. It went in little cheery flocks, and showed such absence of fear, that he had to walk away from it before shooting, to avoid shattering his specimen. After this, with the exception of an occasional great high-soaring kite or great-billed raven, he saw no other bird. On reaching a height a little above 14,000 feet, he stopped again to boil the thermometer and refresh himself with a little lunch. Throughout this ascent, which was easy to climb, he suffered absolutely nothing from want of breath, or mountain sickness; although his three Zanzibari followers lagged behind, panting and exhausted, and complained much of their lungs and head.

"Mounting up a few hundred feet higher than the

last stopping-place," Mr. Johnston said, "and rounding an unsuspected and deep ravine, I arrived close to the base of a small peak, which had been a continual and useful point to aim at during the whole journey from my station. I was now on the central connecting ridge of Kilimanjaro, and could see a little on both sides, though the misty state of the atmosphere prevented my getting any good view of the country. This ridge, which from below looks so simple and straight, is in reality dotted with several small monticules, and cut up into many minor ridges, the general direction of which is, on the southern side, from north-east to south-west. To the eastward I could see the greater part of Kimawenzi rising grandly with its jagged peaks and smooth glissades of golden sand. Westward I still looked vainly in the piled-up clouds; for the monarch of the chain still remained obstinately hidden, and I was at a loss as to how best to approach his awful crown of snow. At length, and it was so sudden and so fleeting that I had no time to fully take in the majesty of the snowy dome of Kibô, the clouds parted, and I looked on a blaze of snow so blinding white under the brief flicker of sunlight, that I could see little detail. Since sunrise that morning I had caught no glimpse of Kibô, and now it was suddenly presented to me with unusual and startling nearness. But before I could get out my sketch-book, and sharpen my chalk pencil, the clouds had once more hidden every thing; indeed, had enclosed me in a kind of London fog, very depressing in character, for the decrease in light was rather alarming to one who felt himself alone and cut off at a point nearly as high as the summit of Mont Blanc. However, knowing now the direction of my goal, I rose from the clammy stones, and, clutching up my sketch-book with benumbed hands, began once more to ascend westwards. Seeing but a few yards in front of me, choked with mist, I made but slow progress; nevertheless, I continually mounted along a gently sloping hummocky ridge, where the spaces in between the masses of rock were filled with fine yellowish sand. There were also fragments of stone strewn about, and some of these I put into my knapsack. The slabs of rock were so slippery with the drizzling mist, that I very often nearly lost my footing, and I thought with a shudder what a sprained ankle would mean here. However, though reflection told me it would be better to return to my followers, and recommence the climb to-morrow, I still struggled on with stupid persistency; and at length, after a rather steeper ascent than usual up the now smoother and sharper ridge, I suddenly encountered snow lying at my very feet, and nearly plunged headlong into a great rift filled with snow that here seemed to cut across the ridge and interrupt it. The dense mist cleared a little in a partial manner, and I then saw to my left the black rock sloping gently to an awful gulf of snow so vast and deep that its limits were concealed by fog. Above me a line of snow was just discernible, and altogether the prospect was such a gloomy one, with its all-surrounding curtain of sombre cloud, and its uninhabited wastes of snow and rock, that my heart sank within me at my loneliness. Nevertheless, I thought, 'only a little farther, and perhaps I may ascend above the clouds, and stand gazing down into the crater of Kilimanjaro from its snowy rim.' So, turning momentarily northwards, I rounded the rift of snow, and once more dragged myself, now breathless and panting, and with aching limbs, along the slippery ridge of bare rock which went ever mounting upwards. I continued this for nearly an hour, and then dropped exhausted on the ground, overcome with what I suppose was an ordinary attack of mountain sickness. I was miserably cold, the driving mist having wetted me to the skin. Yet the temperature recorded here was above freezing-point, being 35° F. I boiled my thermometer, and the agreeable warmth of the spirit-lamp put life into my benumbed hands. The mercury rose to 183.8°. This observation, when properly computed, and with the correction added for the temperature of the intermediate air, gives a height of 16,315 feet as the highest point I attained on Kilimanjaro. I thus came within a little more than 2,000 feet of the summit, which is usually estimated to reach an altitude of 18,800 feet."

He made other ascents during the month he was in high altitudes. The footprints and other traces of buffaloes were seen up to 14,000 feet; but he never caught sight of one of the creatures, nor did he see any of the big antelope, which also wander up to the snow-line. At a height of 13,000 feet he saw three elephants, and at night the shrill trumpeting of these animals could be heard round the station.

On Oct. 18 he found himself, most unwillingly, obliged to leave the elevated settlement and return to Taveita. The relatively great cold they had experienced had reacted very unfavorably on his men's health, and he feared that a longer delay might render them quite unfitted to carry burdens. He intended, however, to make his return journey entirely through a new and hitherto untraversed country, and this project somewhat consoled him for leaving the summit of Kilimanjaro still unconquered.

Their downward journey, part of the way through trackless bush and dense dank forest, was not without adventure and some reward in scenery of great beauty. The average elevation of this country was between 8,000 and 7,000 feet, and the temperature consequently almost cool, ranging from 43° at night to 70° in the mid-day warmth. After some four hours' walking from their camp, they crossed the long ridge that marked the southern flank of Kimawenzi, and began to descend the eastern slope of the mountain. Soon they emerged on a kind of heath-like country, and then looked forth on a splendid view stretching from Mwika to the mountains of Bura and Ukambani (the Kiulu range), with Jipe on one hand and the river Tzavo on the other. After some enjoyable excursions from his settlement at Taveita, finding that his funds would not support the expedition beyond the end of November, he made a rapid journey to the coast by way of Pare, Usambara, and the Rufu River to Pangani. At Zanzibar, finding there were no fresh funds to enable

him to return to Kilimanjaro, he paid off the last of his faithful followers, many of whom had accompanied Thomson on his great journey, and took his passage on the British India steamer to Suez in quite a sulky frame of mind, as sorry to leave his beautiful mountain as many people are to quit England. Travelling overland from Suez, he arrived in London not much more than six weeks after he had caught his last glimpse of the snows of Kilimanjaro.

PROPOSED EXPLORATIONS IN ALASKA.

Several expeditions to Alaska are projected during the coming season. Gen. Miles, commanding the military district of which the territory forms a part, desires to acquire a knowledge of the unexplored region between the head of Cook's Inlet and the Tananah watershed. The course of the Tananah is likewise unmapped, except from hearsay, though often traversed by traders in the last fifteen years; so that the opportunity exists here for a fruitful expedition. It is hoped that arrangements may be practicable by which Lieut. Ray, well known for his successful direction of the Point-Barrow party, may be able to command such an exploration. The plan contemplates work either from the Yukon as a base, with a steam-launch and a small party, ascending in June and July, and returning before navigation closes, or an expedition by way of Cook's Inlet, making the portage to the Tananah, and then descending; but a final decision is not yet reached. The party under Lieut. Abercrombie did not succeed in obtaining native assistance, as expected, and were unable to pass beyond the glacier alleged to obstruct the Copper or Atna River about sixty miles from the sea.

Meanwhile, a party has actually started, under Gen. Miles's orders, Jan. 30, for the Copper River, consisting of Sergeant Robinson and F. W. Ficket, signal-observer U.S.A., and commanded by Lieut. Allen. They intend to go to the mouth of the Atna or Copper River by steamer, and ascend as far as possible on the ice, pushing on by water as soon as the ice breaks up and the freshets are over. They hope to cross the divide from the upper Atna, and descend by one of the Yukon tributaries to the mouth of the latter river, and rejoin civilization at St. Michael's. They may be fortunate enough to make the journey in one season, but are prepared to stay two years. They will add a number of Indians to the party at Sitka, and carry various peace-offerings for the Atna Indians.

Lieut. Stoney of the navy is reported to have a new expedition nearly organized to continue his investigations of the Kowak River. The plan adopted, so far as yet decided upon, is to take a steam-launch, ascend the river as far as possible, and pursue the explorations to its source, and winter in the region if necessary. It is stated that the party is to be composed of sixteen men, which is dangerously large, considering the limited food-resources of the region, and might be advantageously diminished by one-half for explorations in the interior. If the party were to pass over the divide, and investigate the course of the Colville, returning *via* Point Barrow next summer, it would accomplish a praiseworthy and much-needed investigation.

THE DOINGS OF ASTRONOMERS.

Director Hough has continued the work of the Dearborn observatory during 1884 in the same lines as in previous years. Mr. S. W. Burnham has had the use of the great telescope, a refractor of eighteen inches aperture, for observations on double stars; and, in addition to assistance rendered to Professor Hough, he has measured several difficult and interesting binary systems. The observatory has been open on Thursday evenings to members of the Chicago astronomical society, and to astronomical classes from the city high schools; and instruction in theoretical and practical astronomy has been given to the senior class of the Chicago university. The observatory delivers the signals for standard time to the city of Chicago daily.

Professor Hough has employed the great telescope throughout the year, in scientific research, with good results. Thirty-two new double stars were discovered, most of which are difficult objects, and can be observed only when the atmospheric conditions of vision are good. The planet Jupiter has mainly taken his attention, and specially the spots and markings on the disk. The remarkable red spot, first observed in 1878, has maintained its size, shape, and outline, with very slight change, ever since that time. Of late, however, it has experienced a marked change in visibility; which doubtless accounts, in good part, for the statements by other observers with smaller telescopes, that the spot had lost its outline. While from 1879 to 1883 this spot had a retrograde drift in longitude on the surface of the planet, during the past opposition this appears to have nearly ceased. For the rotation period of the planet on its axis, Professor Hough derives 9 h. 55 m. 38.5 s., determined from the mean of six hundred and sixty rotations, and varying only slightly from that for the previous year. The great equatorial belt on the disk of Jupiter is found to be subject to gradual drift in latitude from year to year. Its width has also greatly increased, principally toward the south. A large number of white spots were also observed, of variable visibility, and not absolutely relatively fixed in position. The rate of motion of the envelope in which they are situate, Professor Hough finds to be two hundred and sixty miles per hour, making thus a complete revolution around the planet in about forty-four days and a half. Colored prints of several of the drawings of the planet accompany the report, and are very faithful representations of the salient features of the disk. Delineation with the pencil, however, has been only secondary to the micrometric measurements, of which there are between one and two thousand, fixing with entire precision the positions of the belts, spots, and more important markings.

Professor Hough and Mr. Burnham made frequent examination of the planet Saturn whenever the best conditions of observation were present. They made a special search for markings on the rings, with negative results. The belts on the ball were very conspicuous, but no marking was seen which could be used in determining the period of the planet's rotation.

The conditions of weather in the spring of the year, so unfavorable elsewhere, prevailed at Chicago; and, in their attempts to observe the satellites of Uranus, the astronomers were rewarded with success in observing these difficult objects on only a few occasions.

From the *Observatory* for February we learn that forty-five chronometers are now on trial at the Royal observatory, Greenwich, for purchase by the admiralty; that the small planets (206) Hersilia and (210) Isabella, which had not been observed since 1879, the year of their discovery, have recently been re-observed; that Herr Palisa of Vienna, the discoverer of small planets, being desirous of raising funds for the intended expedition to observe the total eclipse of August, 1886, desires to sell for two hundred and fifty dollars the right of naming the latest discovered small planet (244); and that Dr. Gill, her Majesty's astronomer at the Cape, has obtained a sum of money from the government grant for scientific purposes, in order to enable him to set on foot a photographic survey of the southern heavens. Mr. C. Ray Woods is proceeding to the Cape for the purpose of taking the requisite photographs, and he also intends to continue the work of photographing the solar corona which he lately undertook in Switzerland, under the direction of Dr. Huggins.

The Rev. S. J. Perry, director of the observatory of Stonyhurst college, communicates to the *Observatory* a summary of his observations of the chromosphere in 1884, with an automatic spectroscope by Browning, having a dispersion of six prisms of 60°. He has found the greater part of the past year favorable for this work. The mean height of the chromosphere, which varied little in 1882 and 1883, attaining its maximum in May of the latter year, fell away rapidly in 1884. A great diminution is also reported in the number of the prominences, and some falling off in their average height. The number of observed displacements of the C line differed but little in the last two years; but the amount of displacement was slight in 1884, compared with 1883. No distortions have been recorded during the past two years so great as those of April and May, 1882.

ROGERS'S HISTORY OF ENGLISH LABOR.

Those of our readers who are devoted to political and social science need no introduction to the recent volumes of Mr. Thorold Rogers. It is eighteen years since he published the first two volumes of his history of agriculture and prices, — a work of incalculable value to the critical inquirer. He has since then made an elaborate study of the wages of English labor during the last six centuries, and of their corresponding purchasing-power. The data, which he has collected with marvellous industry, have been printed in part, and in part they still remain in the author's notes. His work is therefore unique. No one, he tells us, has entered on this field of research except himself, and no one has attempted to make use of the data he has published for the purposes which the author has in view; yet, for all his statements, he assures the reader that he can give ample verification. The narrative which he bases upon these inquiries is by no means so statistical as to be dry. The writer is never dull, and is generally entertaining as well as instructive. He brings before the public, information, hitherto hidden, respecting the daily life, needs, burdens, comforts, and helps of the inhabitant of England since the middle of the thirteenth century.

His volume begins with a sketch of English society at that period when the vast majority of persons were engaged in agriculture; and, after devoting six chapters to this introduction, the author proceeds to the subsequent history of wages and labor, and to a consideration of the influence of legislation upon the distribution of wealth. He shows that the evils of pauperism and the degradation of labor were largely due to governmental acts designed to compel the laborer to work at the lowest wages possible. Although this bad legislation has long since been abandoned or modified, the effects remain in England to-day. It will thus be seen that the volumes are a contribution to the historical method of political economy. If the author's figures are correct, and his mode of presenting them trustworthy, it is obvious that he has enabled the statesman and the economist to study the actual results of economic legislation during a period quite long enough to be very instructive. His conclusions have an important bearing upon the spread of communism as well as upon the existence of poverty.

We can perhaps exhibit the tendency of the entire work most readily by giving an analysis of the closing chapter, in which the remedies for present evils are succinctly pointed out.

During the last sixty years parliament has done much toward abrogating severe laws which interfered with the freedom of labor.

Six centuries of work and wages. The history of English labour. By James E. Thorold Rogers, M.P. New York, *G. P. Putnam's sons.* 591 p. 8°.

Much more is to be done, especially in sweeping away the distinction of real and personal estate, in forbidding the settlement of land, and by establishing a cheap and compulsory registration of land-titles. There must also be a revision of local taxation. Such changes must be gradual. The remedies for present evils are not to be sought so expectantly in philanthropy as in the modification of laws and privileges. Other countries, as well as England, suffer from bad government, and even the United States is not free from disastrous laws. When government goes beyond its proper function, it makes itself responsible for failures, and engenders the belief, that, if man is unhappy, government has made him so.

The condition of London is then briefly considered, — 'the greatest manufacturing town in the world,' which levies an *octroi* duty on coal to an amount "which seems insignificant, but is sufficient to *kill* such manufactures as depend on its prodigal consumption." Bad as the condition of London labor is, the author is persuaded that it is not so bad as was that of all urban labor sixty years ago, and that the metropolis is not so ignorant or unclean as it was twenty years ago. The unrestricted reception of foreigners is condemned. While approving of charities in extraordinary cases, the author opposes compulsory and governmental charity on a general plan. "To adopt such an expedient would be to despair of the recuperative power of modern industry," and the relief of poverty would soon absorb all the products of labor. Henry George's plan for the nationalization of land is condemned; so is entail. Migration is commended. Small land-holdings are most desirable. The advantages of trade-unions are pointed out with frankness and emphasis. Finally, the author, seeking for measures which will tend toward the just distribution of material comforts, takes courage for the future in the recollection, confirmed by careful historical studies, that England has taught mankind the machinery of government, and that its free institutions, now spreading through the civilized world, depend upon enlightened public opinion. "The reforms which have been effected are the work of the people, and they are to be traced in the stubborn perseverance with which Englishmen have criticised their own condition, and have discovered that from themselves only can the remedy be found."

Before concluding this inadequate notice of a very important book, we may mention that the last eight chapters, comprising the modern facts, have been reprinted by themselves for general circulation. We may also call attention to an elaborate treatise, well adapted to collateral study, on the subject of taxes and taxation in England, — four octavo volumes just given to the public by Stephen Powell, assistant solicitor of inland revenue.

A NEW GEOLOGICAL MAP OF CANADA, WITH AN OUTLINE SKETCH.

THIS sketch of the physical geography and geology of Canada has been prepared to accompany a new geological map, prepared by the geological survey, in two large sheets on a scale of forty miles to an inch. Both the map and the sketch derive their materials from a review of all the topographical and geological work that has been accomplished in Canada, and give, in graphic and condensed form, a general view of the present state of the physical exploration of the northern part of our continent. The physical geography is not treated with so much attention as it deserves: indeed, the pages of the sketch that are devoted to this subject are more occupied with descriptive than with truly physical geography, and leave much to be said. The geology is given more space, as is natural in the present stage of development of the two studies. Many of its topics will probably continue to excite a controversial interest in the future, as they have in the past: as, for example, the great St. Lawrence and Champlain fault, and its continuation in a series of dislocations "traversing eastern North America from Alabama to Canada," as well as the relation of the formations on either side of it; the Lake-Superior copper-bearing series, which Dr. Selwyn regards as lower Cambrian; the subdivisions of the Archaean, of which only two — the Laurentian and Huronian — are recognized, and even these are not always clearly defined, while the so-called Norian is denied existence in Canada. Intrusive and eruptive masses of Archaean date are properly mentioned with emphasis, although they have "been singularly overlooked or ignored by most writers on American geology." Dr. Dawson's 'western section,' being a region of more recent exploration, has hardly yet reached the controversial stage. His descriptions of the several levels on the plains east of the mountains, and of the little that is known about the northward extension of our Cordilleras, are here presented in good form

Descriptive sketch of the physical geography and geology of the Dominion of Canada. By A. R. C. SELWYN and G. M. DAWSON. Montreal, *Dawson bros.*, 1884. 55 p., map in 2 sheets. 8°.

for study by the younger generation of coming geologists, who have yet to begin their acquaintance with the structure of that vast region.

The geological map is a very welcome contribution to our records of the physical history of British North America. It measures the great progress made in western explorations since Sir William Logan and Professor James Hall prepared the well-known map of Canada and the north-eastern United States in 1866, and presents an authorized graphic digest of the many sketch-maps and reports that have been published since that time. Much of the work is, of course, broadly generalized, and is doubtless open to serious changes; but the great features of the country are well represented, and in the west show a very clear continuation northward of those found within our territory, with the addition of certain peculiarities probably dependent on a more extensive glaciation and a greater recent depression in the northern area. The vast breadth of the horizontal mesozoic and tertiary strata of the plains, between the undetermined confusion of the Archaean on the east, and the paleozoic mountain ranges on the west, gives a character to this region that finds no close parallel in other parts of the world.

The 'general map of part of the north-west territories,' prepared at the Dominion lands-office at Ottawa, may be recalled while mentioning the geological sheets. It represents the region northward from our boundary, between Hudson Bay and the front range of the Rocky Mountains, on the same scale of forty miles to an inch, and, in the latest edition we have seen, is corrected to March, 1883. Its topographic detail, especially as regards the ragged outlines of the numerous lakes drained by the Nelson River, is decidedly greater than that of the later geological map. Both are, we presume, in great part only approximations to the exact truth; but, unless the former is imaginary in its details, the uninitiated can hardly understand why it was not used as the base-map for the geological coloring. Perhaps there is need of better co-ordination of government work in Canada as well as with us.

GOODALE'S VEGETABLE HISTOLOGY.

UP to the time of the translation of Sachs's text-book of botany into English, something over ten years ago, comparatively little interest was felt in vegetable histology and physiology in this country; and no modern English treatise on the subject, of any importance, existed. The direction given to the work of students by Sachs's book was soon manifested by a demand for less comprehensive text-books, adapted to the use of more elementary classes; and Thomé, Prantl, Bessey, and Kellerman have successively appeared as the result of this demand.

Gray's botanical text-book, sixth edition. Vol. ii., *Physiological botany;* i., *Outlines of the histology of phaenogamous plants.* By GEORGE LINCOLN GOODALE, A.M., M.D., professor of botany in Harvard university. New York and Chicago, *Ivison, Blakeman, Taylor, & Co.*, 1885.

While the space given to physiological subjects in the earlier editions of Gray was doubtless adequate when these were prepared, the revision of the book required that these subjects should be treated far more comprehensively than was possible within the limits of the original work: hence the appearance of a separate volume allotted to them.

For convenience the author has divided this volume into two parts, devoted respectively to histology and physiology. The first of these has recently come from the press, and sustains the high character of the work of which it forms a part.

An important feature of this volume is the concise introduction, in which the histological appliances and methods most frequently used are brought together for discussion, the writer's long experience as a laboratory teacher making this condensed account of much practical value to the student. Following this are chapters on the cell and its parts; modified cells, and the tissues they compose; the structure and development of the root, stem, and leaf of phaenogams; and the structure and development of the flower, fruit, and seed.

These subjects are treated in much the same manner as in several of the later text-books, though an unusual degree of facility in grouping the topics in a logical manner is shown; and no opportunity is lost of indicating the practical aspects of the subject under consideration.

While this part maintains the conservatism with regard to insufficiently substantiated theories that characterizes the earlier volume of the text-book, it is well abreast of the times in a branch of botany which is admittedly in a far from settled condition. A marked improvement on the usual classification of tissues is observable in the adoption of a smaller number of types, the limits of which are capable of more precise definition, while the treatment of their derivatives is probably the best possible on a morphological basis. A physiological classification of tissues, based largely on the admirable work of Haberlandt, forms

the last chapter, and will be found of much assistance as an introduction to the physiological part of the volume.

In point of illustration, this stands in marked contrast with the more recent American text-books on related subjects. If the figures do not all possess the highest artistic merits, they are for the most part well executed. Their chief value, however, lies in the fact that very few of them have before appeared in American books. Sachs, which has supplied most of our later text-books with their only meritorious histological illustrations, has been practically discarded. While most of the cuts are copies, many of them are taken from special memoirs not readily accessible to the majority of teachers, and hence are as useful as if original; and those that have been reproduced from other sources have the merit of excellence of execution and ready comprehensibility.

If the closing part of the volume, dealing with vegetable physiology, which, as we understand, is soon to appear, shall maintain the character of that already published, the book cannot fail to meet the requirements of the class of botanists for whom the 'Botanical text-book' was planned.

DISEASE-GERMS.

DR. KLEIN's book is by far the best we have seen on the subject of the pathogenic and septic bacteria. The author has had a thorough practical education in the matter, as he has worked at it experimentally during the last ten years for the medical department of the local government board of England. In this little volume are embodied his own researches, supplemented by those of others, arranged to form an admirable guide, either for those who may wish to work in this field practically or for those who may wish to get merely a critical knowledge.

The first five chapters are devoted to the apparatus and methods employed in the cultivation of bacteria outside of the body, and the precautions which are necessary in order to avoid error. Also the inoculation of animals, and the care to be taken in this, are spoken of here.

An exhaustive account of the morphological characters of all the micro-organisms is not attempted, but only of such as are related to disease in some way or other.

The classification of Cohn is followed; and the micrococci are first taken up, then the bacteria proper, after this the bacilli, then the vibrios and spirilli, and finally the fungi, including actinomycetes.

The descriptions of the appearance and characteristics of the various species are greatly aided by woodcuts giving the shape and particular way of grouping together. The difference in outline between many of the bacteria is so slight that it cannot be attained in the most highly executed plates: therefore it is much better to try to represent their method of association, and the abundance in which they occur in the tissues, than to strive for great accuracy in the delineation of individuals. The last chapters of the book are well worth reading, as they deal with some of the general questions. That on the relations of septic to pathogenic organisms considers the possibility of certain of the former assuming the properties of the latter under extraordinary conditions. Three examples have been brought forward as proof of this: first, the transformation of the hay bacillus into the bacillus anthracis; second, the properties of exciting inflammation in the eye, which the bacillus subtilis of the air is said to assume when grown in a solution of jequirity-bean (Abrus precatorius); and, third, that the common aspergillus, when cultivated under peculiar conditions, is reported to be fatal when inoculated into rabbits. The facts bearing on these cases are carefully reviewed and tested by his own experiments, and he comes to the conclusion that in each case there is an error. In the first it arises from the accidental contamination of the nutritive fluid; in the second it is not the microbe which is the active agent, but a peculiar chemical ferment (abrin) which is contained in the beans, and has also been obtained from other parts of the plant; and in the third the fungus acts simply mechanically, and not as a toxic agent, in causing death. The septic alkaloids (ptomaines) and the zymogenic ferments are noticed in the chapter on the vital phenomena of non-pathogenic organisms. He takes up the subject of vaccination and immunity, and concludes that the weight of evidence tends to show that the milder form of disease furnishes some substance, not as yet demonstrated, in addition to those already in the system, which acts in preventing the development of the severer forms. In the last chapter, attention is directed to antiseptics;

Micro-organisms and disease. An introduction into the study of specific micro-organisms. By E. KLEIN, M.D., F.R.S. London, *Macmillan*, 1884. 8°.

The formation of poisons by micro-organisms. A biological study of the germ theory of disease. By G. V. BLACK, M.D., D.D.S. Philadelphia, *Blakiston*, 1884. 12°.

and it is shown that the greater number simply hinder the development of bacteria, and in no way destroy their powers when they are again placed under suitable conditions.

The little volume may be summed up as clear and concise, well illustrated, and inexpensive.

Dr. Black has adopted a rather high sounding title for a course of lectures delivered to the students in the Chicago college of dental surgery. There is no evidence that he has worked practically at the subject, and the generalizations to which he is inclined have to be made entirely upon the work of others which he has not controlled. He thinks that all the processes causing cell destruction or absorption are a sort of digestion, and that micro-organisms act by digesting the cells, or else they are digested by them. Perhaps, if the subject-matter had been a little more digested by the author, he would not have felt himself called upon to publish these lectures.

BILLINGS'S VENTILATION AND HEATING.

This book is a reprint, in revised form, of a series of articles which appeared in *The sanitary engineer* in answer to a typical questioner who asked for a rule-of-thumb method for solving problems in ventilation, and who failed to recognize the legitimate relation between 'long-winded discussions on the physics of gases,' and ventilation. The author urges a thorough knowledge of the mechanics of gases, and of the laws involved in their free and constrained movement, as essential to any competent judgment upon the solution of the various pneumatic and thermal problems peculiar to heating and ventilation.

Pecuniary rather than constructive or functional difficulties are stated to be the most serious encountered in providing good ventilation. A partial antidote for scepticism as to the efficiency of any method, because of the frequent entire or partial failure of elaborate and costly systems put to the test of actual use, appears in the description given of systems in successful operation in various types of buildings. If the causes of failure in less successful undertakings had been clearly pointed out, the faith of many would have been still further strengthened. A discussion of the comparative cost of heating, with and without conjoined ventilation, would also have served the good purpose of furnishing needed information, and of allaying any undue apprehension growing out of the author's statements which make ventilation dependent on liberality of expenditure. The ordinary cost of ventilation does not necessarily represent the minimum cost under conditions of maximum economy and efficiency; and it is along these lines that the progress is to be made which shall inspire confidence, and create demand.

The book is a valuable contribution to the literature, rather than to the science, to which it pertains. It furnishes a clear statement of the fundamental principles involved in the art of heating and ventilation, and describes its methods and results in their application to the numerous and varied illustrations cited. In style, the book is fresh, vigorous, and perspicuous; the occasional flashes of the author's individuality lending a charm the more complete because unmarred by dogmatism. Though occasional statements may provoke marginal interrogation-points, the book is an eminently safe guide, and easily takes a leading place among the works of its kind which have appeared in American literature.

Ventilation and heating. By J. S. Billings. New York, *The sanitary engineer*, 1884. 8°.

NOTES AND NEWS.

It is suggested by G. P. Putnam's sons of New York to secure for the publications of societies the same advantages that are possessed by the issues of publishers, by having them fully described in a priced and classified catalogue, to be made up, say, twice a year, and to be distributed as widely as are the book-lists of publishing-houses. There are at present in the United States some seventy scientific and historical associations which issue in the course of the year transactions, proceedings, or monographs. Many of these publications possess an interest and importance for the general public, and find sale outside of the special circles of the members of the societies for whom they are more particularly prepared. The general sale of such society publications could be materially increased, to the advantage as well of the special interests they are planned to further, as of the various publication-funds, if provision were made for some trustworthy means by which the general public might secure prompt information concerning the works issued, and for some regular channel through which could be supplied the increased demand that such information would unquestionably induce. Each society whose publications are included in the catalogue, will, under the plan proposed, contribute a small annual payment towards the cost of its preparation, while the publishers will assume the payment of such deficiency as may remain.

— D. G. Brinton of Philadelphia announces as in press "The Lenâpé, and their legends; with the com-

plete text and symbols of the Walam olum, a new translation, and an inquiry into its authenticity," by himself.

— At its annual meeting, Jan. 21, the Russian geographical society awarded the Constantine medal to A. Woeikof, for his researches on climatology, especially for his work entitled 'Climates of the globe;' Count Lutke's medal to Col. N. J. Zinger, in consideration of his method of determining time by the observation of two stars, — a method combining accuracy with simplicity without the aid of heavy instruments, and especially suitable for geodetic work (it has already been used in Caucasus, Bulgaria, and other places); the medal of the ethnological section to P. W. Schein, for his study of the folk-lore of White Russia; the medal of the statistical section to Prof. T. Janskeel, for his report on factory statistics of the Moscow region. Inferior gold medals were given to Putkata, Iwanow, and Bendersky (Ramir travellers); to Professor Klossowsky, for his studies of thunder-storms in Russia; and to Professor Zomakion, for magnetic observations at Kasan in 1882–83 on the international plan. The most important recent publications of the society are the map of the Baikal by Chersky, and the atlas showing Gen. Kaulbars's work on the Amu Sarja.

— Among the prominent members of the Russian geographical society who died during the past year was Count A. S. Uwarow, one of the first archeologists of Russia, and founder of the Archeological society of Moscow. His first work was an investigation of the archeology of southern Russia. Later he made a very thorough examination of the tumuli on the Oka (Wladimir), and published an important work on the Finnish people of the Meria, who inhabited the country before its colonization by the Russians. For this work he was awarded the Constantine medal of the society. The last fifteen years of his life were devoted to the study of prehistoric archeology.

— The electrical exposition, organized by the International society of electricians at the Observatory of Paris, will open March 15. The exposition will be the first in a series of special expositions preparatory to the great universal and international festival in 1889.

A KANSAS TORNADO IN APRIL, 1884.

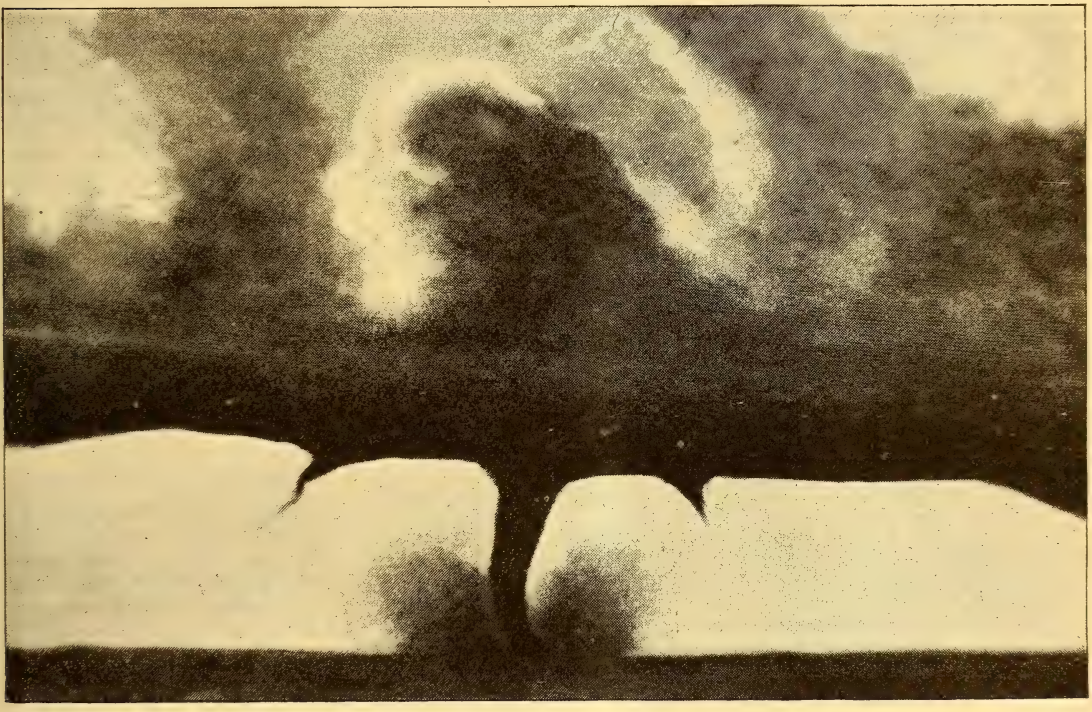
— Capt. Mitchell of the English steamer Wentmore reports that on Jan. 28, at half-past two A.M., a ball of St. Elmo's fire fell between the bridge and foremast, and afterwards played upon the foremast and gaff. This ball of fire was so bright that for a time it blinded the officer on watch.

— Ambulance classes for railway employees have been instituted in Berlin, and it is intended that in future every German railway official shall be an accomplished student of the Esmarch ambulance system.

— Mr. Cochery, the French minister of posts and telegraphy, was present at Rouen, Jan. 2, at some experiments in long-distance telephoning. The object was to test the application between Rouen and Havre, a distance of about ninety kilometres, of the simultaneous transmission system of Van Rysselberghe. The result was excellent, and Cochery announced that the communication would be open to the public in a fortnight. It is probable that before long there will also be a connection between Rouen and Paris, using either the Van Rysselberghe system or a special wire, according to the cost. Since Jan. 1 the first public telephone-offices have been in operation in Paris.

— The January number of the *American meteorological journal*, edited by Professor Harrington of Ann Arbor, Mich., and published at Detroit, is of more than usual interest. Among the meteorological papers, one by Mr. H. H. Clayton, jun., on the 'Thunder-squalls of July 5, 1884,' is of much value. A new feature that appears in this number of the journal is twelve pages of methodical review by various contributors. If extended and continued, this will form a current bibliography of great value to many readers who are unable to consult a large variety of publications. The number contains a woodcut (here produced) prepared from a photograph of a tornado that occurred in Kansas last April. The view was taken by Mr. A. A. Adams, Garnett, Kan., from whom copies may be bought. Another tornado photograph was taken in Dakota last August by F. N. Robinson of Howard, Miner county, from whom copies may be obtained. The storm passed twenty-two miles west of that town, moving in a

south-easterly direction. It was first noticed at four o'clock, and remained in sight over two hours. Several persons were killed, and all property was destroyed along its track. This view has already been published in *Nature* and in the *Comptes rendus*, while its appearance here has been delayed on account of its having been copyrighted. Although the destructive effects of tornadoes have often been photographed, we believe these are the first views ever taken of the tornado itself. No others of the kind are found in the great collection of tornado illustrations in the U. S. signal-office at Washington. It is due to our readers to say that our knowledge of the authenticity of these two views depends simply on the tacit guaranty given by their owners, and that the second one especially bears evidence of having been somewhat 'touched up;' but, in any case, they are certainly unique. It is to be hoped that there may be additional examples reported of this new use of the camera before the coming season is over.



FROM AN INSTANTANEOUS PHOTOGRAPH OF A TORNADO IN DAKOTA.

— The veteran Chevreul, who is approaching the close of the hundredth year of his age, presided the first week in January, in Paris, at a meeting of the new Student's association. It is needless to say that he was enthusiastically received. He spoke of himself as being still merely a student.

— The government astronomer of the colony of Victoria has recommended that a party be sent to New Zealand next September to carry out the necessary physical and other investigations for which the eclipse of the sun in that month will present a favorable opportunity. "The occurrence," he says further, "of long-continued earthquake disturbances in Tasmania during the past year, and the tendency they have lately exhibited to extend to the southern part of Australia, coupled with the probability that they are indicative of a new cèntre of seismic action not very far removed from the eastern portion of Bass's Straits, suggest the propriety of establishing some seismometer apparatus at our observatory; and I have now under consideration the question of the form of apparatus best suited for this locality."

— Mr. Lauth, the superintendent of the porcelain factory at Sèvres, is said to have discovered a new porcelain which is far superior to the celebrated old Sèvres. After ten years' experiment and investigation, he thinks he has produced a porcelain identical with that of China. Not only does it lend itself to artistic decoration, but it takes all kinds of glazes, and surpasses in beauty the colors obtained in China.

— Our imperfect knowledge of the more obscure forms of marine life is shown by the fact that a new parasitic copepod has just been discovered in the gill-tubes of the ordinary clam (Mya arenaria), and described in the *American naturalist* for February. It is rather large, and belongs to the group Poecilostomata. The male is found in a free state in the mantle cavity.

— The first part of the new 'Journal of the New-York microscopical society' has appeared as a well-printed octavo of thirty-two pages. It is to contain the transactions and proceedings of the society, and to be published in nine monthly numbers, from November to July inclusive, at one dollar per annum. The present number contains an abstract of Stein's article on electrical illumination for the microscope, which appeared in the *Zeitschrift für wissenschaftliche mikroskopie;* a short critical essay on pollen-tubes, by Dr. Britton; the report of the proceedings of the society; and, finally, an 'Index to articles of interest to microscopists.' From the examination of the journal, we conclude that the society opens its career with good prospects; and we find among the members a number of familiar and esteemed names, which makes us hope that it will prove something more than an association of *dilettanti.* Cornelius van Brunt is president of the society, and B. Braman editor of the journal.

— The *Deutsche geographische blätter* of Bremen publishes a 'sociological essay' on the Kongo tribes, written by Mr. R. C. Phillips, an old resident at Ponta da Lenha. The writer deals more especially with the social condition of the tribes with whom he was brought into contact, and only incidentally enters into questions of commerce and international policy. What he says about the recent 'annexations' and purchases of land by the International association, the French, and the Portuguese, is of some interest just now. It is quite clear that the native chiefs, when they signed the documents so ostentatiously made public, never meant either to 'sell' the land of their tribes, or to place themselves under the sovereignty or protection of foreign powers.

— The following three monographs, part of the larger work on the fauna and flora of the Bay of Naples and the neighboring coasts, will shortly be published by Engelmann of Leipzig: 'Doliolum,' by Dr. Basilius Uljanin, with twelve colored lithographs, ten zincographs, and a woodcut; 'Polycladae,' by Dr. A. Lang, with fifteen lithographs; 'Cryptomeniaceae,' by Dr. G. Berthold, with eight colored lithographs.

— The eighteenth volume of the new edition of the 'Encyclopaedia Britannica' is to be published this month. It opens with the article 'Ornithology,' of Prof. A. Newton: and among the other scientific articles are 'Oysters,' by Mr. J. I. Cunningham; 'Pacific Ocean,' by Mr. J. Murray; 'Parasitism,' treated under the three heads, 'animal,' 'vegetable,' and 'medical,' by Mr. P. Geddes, Mr. Milne Murray, and Dr. C. Creighton; 'Pathology,' by Dr. Creighton; 'Photography,' by Capt. Abney; and 'Phrenology,' by Professor Macalister. 'Philology' is dealt with by Professor Whitney of Yale, and Prof. E. Sievers of Tübingen.

— The fourth edition of 'Tables, meteorological and physical,' by Professor Arnold Guyot, has just been published by the Smithsonian institution. The preceding or third edition was published in 1859; and though stereotyped, it was thought advisable to have this new edition entirely reconstructed. It now forms an octavo volume of seven hundred and sixty-three pages, and is offered for sale at the price of three dollars. The first series of tables (fifteen in number) embraces thermometrical comparisons and conversions; the second (of thirty-three tables), hygrometrical computations; the third (of twenty-seven), barometrical tables; the fourth (of twenty-six), hypsometrical tables; the fifth, geographical tables of conversions, including forty-nine tables of measures of length (for heights, etc.), ten tables of itinerary measures, and ten tables of square measures, or measures of geographical surface; the sixth (of ninety-nine), tables for corrections of variations of temperature, etc., at different parts of the earth; the seventh and last series (of nine tables) embraces miscellaneous tables.

— The brothers Donhardt have reached Zanzibar, and will continue the explorations in the interior of eastern Africa, which they began in 1878 and 1879.

— The International association has sent out an officer to open a station between Karema, on Lake Tanganyika, and the station at Stanley Falls, on the Upper Kongo. A transcontinental route will then be opened by steamer up the Zambezi and Lake Nyassa, across the Stevenson road to Lake Tanganyika, thence by the new station to Stanley Falls, and so down the Kongo.

— The two Austrian explorers, Dr. von Hardegger and Professor Paulitschke, have sailed from Trieste for Aden, whence they mean to go to Harar, and make scientific studies, and collect specimens between there and Sela.

— The general geographical conference of the Australian colonies, to be held at Melbourne, is to discuss the necessity of defining the exact meaning of the geographical term 'Australasia,' the compilation of a reliable work on the geography of Australia for Australian schools, the New-Guinea exploration, and the discovering and defining of the exact boundaries of what may now be termed 'British New Guinea.'

— It is stated in the anthropological notes of the *Athenaeum*, that Deniker's study of the Kalmucks, which has appeared in the last five numbers of the *Revue d'anthropologie*, is now complete. He remarks that in Russia, as in China, the Kalmucks are little by little losing their originality, though not so quickly as some other peoples; and that the time is not far distant when there will only remain of this ancient and warlike people, which has its own literature, religion, and laws, some thousands of peaceable subjects whose physical type will perhaps be all that will be left to prove their Mongolian origin. In sooner or later absorbing themselves into the rest of humanity, however, they will certainly add to the mass some traits of character distinctively their own. The same author has also published an investigation into the foetus of the gorilla; a specimen of which, the only one which has ever reached Europe, is in his hands, and has been described by him to the Society of anthropology of Paris.

SCIENCE.

FRIDAY, FEBRUARY 27, 1885.

COMMENT AND CRITICISM.

The map and geographical article by Lieut. Greely, which appear in this issue, may fairly be said to contain the most important additions to the geography of the polar regions which have been made in some years. The importance of the discoveries of the Greely party lies not merely in their extending the area of mapped coast, but also in the distinctive, and to some extent unexpected, character of the physical features of the region now first pointed out. The continuation of North Greenland in the direction and manner determined by Lockwood and Brainard was not unforeseen, or at least is what might have been reasonably predicted. The information as to the narrowness of Grinnell Land and the trend of its western shores is hardly what any one would have anticipated; and the discovery adds piquancy to the ordinary interest of new exploration. In this connection, the information reported by Dr. Boas is of peculiar interest. It will be singular, indeed, if it finally appears that the channel of Smith Sound, and its continuations, are projected like a 'covered way' into the realm of ice, as if for the especial benefit of explorers. The absence of any considerable body of land north-west from Grinnell Land must have an important bearing on the question of the ocean-currents of the arctic region. We commend the map to the consideration of a well-known geographical amateur, who, if telegraphic despatches are to be trusted, immediately after the receipt of the first 'cablegram' of Greely's explorations, made haste to assure the British public that there was no reason to suppose that Greely's party had been farther north-east than Beaumont Island, and that their own supposition that they had made progress was doubtless an entire misconception! The adverse critics of arctic work should bear in mind that the entire geographical and scientific work was accomplished without disease, disaster, or even serious frost-bite.

A recent extension of the work undertaken by the secondary meteorological services of our country is the establishment of local signals, indicating the coming changes of weather as telegraphed from the signal-office in Washington. This has been attempted by four of the local services. Ohio led the way a year or more ago by arranging with several railroad-lines for the display of colored signals on the sides of the baggage-cars, and this system has been extended into Canada and Pennsylvania. Louisiana had at last accounts sixty-seven stations at which flags were hoisted to forewarn the planters of probable frosts. Alabama has a system of three flags in nine combinations, in operation at about thirty stations. The system is approved, and is extending month by month. Several towns in New England are adopting the Ohio system, introduced here through the New-England meteorological society. Besides all these, there is a considerable number of volunteer-stations at which the 'cold-wave' flag is displayed.

The latest suggestion for local signals comes from Vermont, where it is proposed to spread the indications by factory-whistles. The point is made that the out-of-town farmers, who have especial need of the weather warnings, have the smallest opportunity of learning them soon enough, either from newspapers, post-office bulletins, or local flags. Blasts from powerful steam-whistles could, on the other hand, be heard five or more miles around; and they would carry the news to nearly every part of a manufacturing state. All the Vermont boards of town selectmen are to be petitioned to consider the matter, and we shall be glad later in the season to announce good progress in the work.

WHAT IS a microscopist? First and last, an amateur who rejoices in the beautiful variety of microscopical specimens; one who treasures slides in the exact centre of which is a ring of cement neatly put on, and holding a cover-glass under which lies some fine test-object, — a delicate diatom, a podura scale, a bit of tissue the vessels of which are injected with gorgeous red, a polarizing crystal: in short, almost any tiny scrap of the universe, if so it be pretty in the pattern of its shape and color. These same treasured slides must have neatly bordered labels, and be catalogued and stored by a special system. The microscopist is one who has a formidable and extensive deal of brass stand, which can hold together a cabinet of appliances; and he will display the most admirable patience in getting them in position, until at last he sees the specimen, and is ready to clean and pack away his apparatus. His series of objectives is his glory; and he possesses a fifteenth of Smith and Brown, which will resolve a band of Nobert's not to be resolved by the objectives of any of his friends. His instrument is his pet: about it his interest centres, while the direction of his studies is determined, not by any natural bond between the objects, but by the common quality of minuteness. Is it not curious? Imagine any one deliberately setting out to study whatever he could cut with a knife. We should pity the man who chopped up the sciences according to the instrument he used. We cannot be brought to regard anatomy as a department of cutlery, nor can we seriously admit histology as a department of microscopy.

Scientific men have been very lenient towards the microscopists; and yet the latter, who have long been allowed to march as hangers-on to the regular scientific army, have gradually lagged behind. The army has grown, and divided into many separate corps, traversing the country of the unknown in all directions, and the microscopist knows not whither to follow. If he turns in any direction, he must join with the special work there, and can glean only in one field: he is no longer the universal gatherer. One must be of the army to be with it, and the forces are too scattered for any hanger-on to flit from one division to another. The would-be microscopist has no place among scientific investigators. He must enlist in one company and there remain, or else be content to rank as an amateur, and not as a scientific man.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The north magnetic pole.

WITH my article in *Science*, No. 98 (Dec. 19, 1884), entitled 'The Netschilluk Innuit,' there appeared a map of the distribution of those Eskimo, in which I placed the north magnetic pole in about longitude 99° 35′ west from Greenwich, or about sixty-five miles due west of the position given by Ross, its discoverer, in his sledge-journey of 1831. Since this map was issued I have received two letters from well-known scientific gentlemen, and a personal inquiry from another, asking why I so mapped this change in the magnetic pole, and on what observations or conclusions it was based, even though I had put an interrogation-point after the words indicating the position. It is well known that many calculations have been made respecting the western movement of this pole since its discovery; and, varying as they do, they all, so far as I have seen, would place it much farther to the west, for the year 1879, than my location gives it.

The above inquiries and facts make me think it would be interesting to give in your publication the rude and approximate manner in which I located it as above, leaving each one to judge of its value. Its latitude I assumed to be the same as that determined by Ross, as all writers speaking of its revolution, whatever be its rate, give the geographical pole as its centre. Its latitude, therefore, would not vary. I consider this co-ordinate, determined in this manner, by far the most unreliable of the two; I believe, however, that those interested in the subject will consider it also the least important, as being the least likely to vary considerably. My only instrument for determining the position of the pole was an ordinary compass, but an extremely delicate and reliable one in its proper sphere, and returning to the same point, in the temperate zones, to within less than a degree of arc started from any position that could be given. When at Cape Felix, the most northern point of King William's Land, the needle remained sluggishly in almost any position that was given it; when pointed in a north-east or south-west direction, I thought I detected a slight tendency to move to the westward. At Franklin Point I made some seventy-five to one hundred observations (the exact number I have in my journals, packed in Portland, Ore.; but I think my memory will be close enough for descriptive purposes, and probably more exact than the rough approximations), and the horizontal needle now commenced to show a little activity; a mean of the observations showing about longitude 99°, where its direction cut the Ross latitude of the magnetic pole. Near Point Little, I took the longest and most careful series of observations, and the needle always returned to within 18° (this I distinctly remember) of the pole as I have located it in the Netschilluk map, and this

return was made from every quarter-point of the compass several times (my records show this more accurately). My other observations of similar character were at camp on Terror Bay, and at Reindeer Camp on Simpson's Straits. All of these points are somewhere between 99° and 100° west longitude; and I firmly believe the observations sufficiently accurate to say, in no rough way, that in 1879 the north magnetic pole was between these two meridians, with its latitude quite undetermined.

In the fall of 1880 I published a small note about this interesting point, in which the above appeared, and also a few calculations regarding the westward rate of progress, which I cannot give from memory. I think that the thermometric observations close to this district, straggling and interrupted though they were, go far to prove that the magnetic pole, and pole of minimum depression, are identical, or nearly so. FRED'K SCHWATKA.

New-York City, Feb. 9.

Total eclipse of the sun in August, 1886.

In the year 1886, Aug. 28–29, will occur an eclipse of the sun, whose maximum duration of totality is over six minutes of time. Opportunities like these for the study of solar physics are sufficiently rare for astronomers to be always eager to improve them whenever it is deemed practicable. Although the circumstances of this eclipse are found upon examination to be beset with peculiar difficulties, still it may not be amiss to make a statement of them, that the possibilities of its observation may be clearly understood.

In this eclipse the axis of the moon's shadow, soon after touching the earth, passes very near or through the following islands, — Los Roques, Orchilla, Blanquilla, Grenada, and Cariaçoa, — which are some of the Windward Islands which skirt the northern coast of South America. From this point the shadow sweeps across the broad Atlantic, and touches no land until it reaches the African coast at Benguela, which place lies almost exactly on the central line.

By examination of the chart of this eclipse, published by the 'American ephemeris,' it will be seen that the totality will occur only about half an hour after sunrise at the most favorable station in the West Indies, with a duration of totality of about three and a half minutes. On the African coast the duration of totality is about four and a half minutes, and the altitude of the sun is amply sufficient for favorable observation.

Benguela is about four hundred miles south of the mouth of the Kongo, and about two hundred miles south of the mouth of the Koanza. The climate of the lowlands bordering the coast near Benguela is fatally unhealthy for strangers, making it compulsory, on the score of prudence, for an observing party to penetrate the interior sufficiently to attain the mountainous highlands which lie not far inland.

The American board of commissioners for foreign missions has for some three years occupied two mission-stations in this region; viz., Bailundu, about a hundred and thirty miles eastward from Benguela, and Bihe, about seventy miles south-east from Bailundu. Through the courtesy of Rev. Judson Smith, D.D., secretary of the American board, and Mr. Frederick A. Walter, secretary of this west-central African mission, I have received definite statements of some of the precautions necessary, and some of the difficulties to be encountered by an observing party locating in this region. I will give in brief the points with which Mr. Walter favors us.

Dangers to the person from savages are not to be apprehended. The climate of Bailundu and vicinity is exceedingly salubrious. During a residence of nearly three years, Mr. Walter and his family have experienced no illness to be ascribed directly to the climate, but in every case to overwork, over-exposure to the sun, or want of proper food.

The difficulties in reference to transportation are considerable. Transportation is done entirely by men: wagons and animals cannot be used. The gross weight for a carrier is from sixty-five to seventy pounds: commonly it does not exceed fifty-eight pounds. Packages, either bales or boxes, should be of about the following dimensions: fourteen inches by nine inches by thirty inches, or, if more convenient, sixteen inches by ten inches by twenty-four inches. No single package should exceed eighteen inches in width by ten inches in depth. Pieces not exceeding sixty pounds in weight, though eight or ten feet long, can be carried by a single carrier.

As to means of subsistence, an observing party must bring *all their supplies with them*, as it is essential to the health of new-comers that they should live on food to which they are accustomed. The time required for a round trip of a caravan from Bailundu to Benguela may be stated as one month to six weeks.

Mr. Walter states that the chances for clear sky at the time of the eclipse are very favorable.

It may be stated that the land rises very abruptly as one leaves the coast from Benguela, and in a few miles attains a very considerable altitude, and throughout these highlands the climate is very healthful. A. N. SKINNER.

A simple calendar reform.

Reform in the standard of daily time having now been happily accomplished, to the great convenience of the public, another simple reform in the monthly calendar remains desirable, which would greatly simplify commercial calculations, and computations depending on the calendar. In our present calendar the disturbing elements which cause inconvenience are connected with the month of February, which at once is shorter than the average month, and also disturbs the revolution of the Dominical letters by the addition of the intercalary day in the leap-years. From this method of inserting the intercalary day in the midst of the year, arises the necessity of having two Dominical letters in the leap-years, and of distinguishing the two unequal parts of such years in all calendar computations.

Now, it is evident, that, if the intercalary day were inserted at the end of the year, the revolution of the Dominical letters would go on undisturbed, and we should never have more than one in any year. But as December already has thirty-one days, to obviate the inequality of months, one day should be taken from it, and one from some other month of thirty-one days, say July, and both be added to February. Thus an equality would be established, as nearly as possible, by an alternation of months of thirty and thirty-one days each, with the least possible alteration of the existing calendar. In each half-year, any two successive months (with the exception of November and December in ordinary years) would have sixty-one days, and each quarter not less than ninety-one, nor more than ninety-two days.

As it is now, the first two months have usually only fifty-nine days, while July and August have sixty-two; the first quarter has ordinarily only ninety days, while the third and fourth quarters have each ninety-two days. The new arrangement would establish a simplicity and symmetry in the calendar, which

would prove a great convenience to the business and scientific public, and equalize the time value of the calendar months and quarters.

A very suitable opportunity to introduce the improved calendar would be on the first recurrence of the leap-year, in 1888. In the mean time the proposed change could be fully discussed and ventilated.

The following table will show the relations of the old and the new calendar to each other: —

DAY OF YEAR.

Old calendar.				New calendar.			
Jan.	31		31	31	Jan.	31	
Feb.	28-9		59-60	61	Feb.	30 *	
March	31		90- 1	92	March	31	
		90-1					92
April	30		120- 1	122	April	30	
May	31		151- 2	153	May	31	
June	30		181- 2	183	June	30	
		91					91
July	31		212- 3	213	July	30 *	
Aug.	31		243- 4	244	Aug.	31	
Sept.	30		273- 4	274	Sept.	30	
		92					91
Oct.	31		304- 5	305	Oct.	31	
Nov.	30		334- 5	335	Nov.	30	
Dec.	31		365- 6	365-6	Dec.	30-1	
		92					91-2

* In transferring from old calendar to new, from March to July inclusive, deduct *two* days; from August to December, deduct *one* day. Thus March 1 (old calendar) will be Feb. 29 (new calendar); but Aug. 1 (old calendar) will be July 30 (new calendar).

The following adaptation of the old lines may serve to assist the memory: —

30 days, *July*, September,
April, June, and November,
February and *December;*
The last, in leap-year, 31,
And always the remaining five.

EDWARD P. GRAY.

Ingersoll's 'Country cousins.'

Absence from home has delayed until to-day my seeing the extended (and therefore highly complimentary) notice of my "Country cousins: short studies in the natural history of the United States," to which you were good enough to give space in your issue of Feb. 6.

Acknowledging its kindly tone throughout, I wish to retort with equal courtesy (if possible) upon your writer at the point where he seems to find most fault; namely, my assertion that the flukes of the whale and other cetaceans represent the hinder flippers of the seal and the hinder legs of terrestrial quadrupeds. That anybody should deny this, surprised me. The language in which I expressed the statement was less precise than that demanded by a technical treatise, as 'Country cousins' makes no claim to be; but only a captious construction could make out that I meant more by what I said than that in a general way the flukes of the Cetacea were representative (in a greatly altered condition, of course) of the hinder flippers of a seal, and structurally were quite as distinct as they, from the forked tail of a fish.

Leaving my assertion and possible evidence out of the question, I should like to know what the comparative anatomists of the country have to say as to this point between my critic and myself. Do not Dr. Elliott Coues and Dr. Theodore Gill teach that a whale's fluke is directly homologous with the integumentary portion of the hinder limbs of the rest of the Mammalia? Of course, every one knows there are no *bones* there. Has not Professor John Ryder discovered, since my pages were in type, that the nerves which supply the flukes are not those which pass along the spine into the tail (where it exists), but, on the contrary, are homologues of those in the higher mammals, which, branching from the spinal cord in the lumbo-sacral region, supply the hinder limbs? What has embryology to show as to the genesis of the flukes? Do they arise structurally as the forks of a tail, or as limb-appendages? It is just possible that the inaccuracy and carelessness with which I have been rather freely accused have been over-estimated.

ERNEST INGERSOLL.

New Haven.

[In respect to the criticism of 'Country cousins,' to which the author of the work so warmly but courteously objects, it may be sufficient reply to quote the statement criticised by the reviewer, which is as follows: "If I had the time, I could prove to you that the difference between the fin of a fish and the bone-leg of an otter or of a dog, or of our own arm, is not so very great; and it would be easy to show how nearly alike the flipper of the seal and fore-leg of a land mammal really are. . . . The same comparison will hold good for the hind-feet of the otter and the hind-flippers or 'tail' (which is *not* a tail) of the seal; and it is equally true of the walrus, *and of the whale, porpoise, grampus, black-fish, and other cetaceans.*" Not a word is said about the 'flukes' of a whale, nor is any reference made to the 'forked tail of a fish,' in the passage criticised. We again submit that this is 'evidence of either ignorance or carelessness' on the part of the author. It is at least a grossly slipshod use of language. — REVIEWER.]

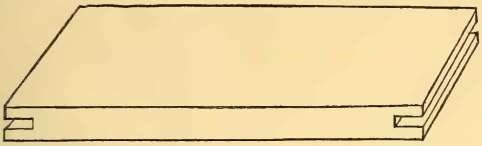
A new method of arranging entomological collections.

A very large proportion of the time of a faithful curator of a growing entomological cabinet is devoted to the re-arrangement of his collections, — to simply pulling pins from one place in a cork-lined box, and putting them into another. In large and well-endowed museums this labor can be lessened somewhat by leaving spaces in the boxes for additions; but in an ordinary entomological cabinet this is obviously impracticable, and, even where this plan is adopted, it affords only partial relief. The advance of knowledge is constantly changing our ideas as to the sequence of species; and from time to time the appearance of a monograph necessitates the re-arrangement of our collections, if we would have them represent the present state of science.

But so great is this labor of re-arrangement, that only few if any of the larger collections are kept in any thing like perfect order. And the faithful curator is forced to give to mere manual labor, time which otherwise would be devoted to original research.

About two years ago I devised and put into use a mode of arranging collections which reduces to a minimum the labor of re-arrangement. This system is an application to entomological cabinets of the principle which underlies the slip system of keeping notes. Its fundamental idea is to fasten in each

case all the specimens illustrating a single species upon a separate block. A standard size of block is adopted for what may be termed the 'unit block.' The size of this block will depend on the size of the drawers in the cabinet. Other blocks which are multiples of this size are also used. The blocks are made of soft non-resinous wood, basswood, or cucumber-tree. They are cut from well-seasoned boards three-eighths of an inch in thickness. I do not find it necessary to fasten the larger blocks in place in any way, beyond keeping the full number of blocks in each box. In each end of each block there is a groove (see figure). Small hard-wood strips are



made to fit into these grooves. In case of the larger blocks, these strips tend to prevent warping. The narrower blocks, such as would be used to mount a single row of small beetles, are fastened together by means of these strips into groups of three or four. Each of these groups are as stable as a single large block. When the blocks are in place in a drawer, the strips are entirely concealed. As the blocks can be cut with a circular saw, and the grooves and strips made in the same way, they are not necessarily expensive.

J. Henry Comstock.

TOO MANY NAUTICAL ALMANACS.

About the most distinguishing feature which characterizes the exertions of men at the present time is that of co-operation. Not only do men act in conjunction with others at home in attaining desirable and similar ends, but there is growing to be more and more a union of purpose for the attainment of such ends throughout the entire civilized world; and this has already assumed proportions never before known in human history. It is amply illustrated in the numerous international conventions, associations, and congresses, only a few years ago quite unknown, or in embryonic existence only in a few scientific heads too wise to propound such things before the eligible moment.

Now, all this is the best sort of evidence of the world's general scientific growth; for the principle of conjoined and united endeavor is based on the broadest science. If, then, the work in any science, or of any body of scientific men, should be more entitled than another to receive, and more willing to accept, the advantages accruing from co-ordination of effort, it would seem that the exact sciences should have the preference. The resolutions of the International prime meridian conference, held at Washington last autumn, are now familiar to all. The action of the astronomer royal of England, the first of January, 1885, in regulating the time-keepers of the observatory in accordance with these resolutions, may be expected to necessitate further changes in the details of observatory work, and the publication of observations, as also modifications in the printing of nautical almanacs and astronomical ephemerides, or a different understanding of them as now printed.

All these matters ought to be definitely settled at no late day; and, as a large number of governments are interested therein, their representatives should convene in a congress for mutual agreement on the details of the modifications to be made. Such a congress might also deliberate upon the advisability of adopting certain suggested improvements of the Gregorian calendar at the end of the present century. Such power should be granted, that the deliberations of the congress might determine, as well as recommend.

Whatever may be said of the national observatories, we are not sure that the deliberations of such a congress, if conducted on the broadest ground, would not lead to a resolution recommending the discontinuance of two or three of the nautical almanacs now published. In so far as the uses of the navigator are concerned, all nations will now experience the need of a nautical almanac for their several meridians, much the same as all patent-medicine firms and pill-venders feel the need of an almanac and calendar for the conservation of individual interests: it saves themselves and their patrons the indignity of referring to somebody's else almanac, and advertises the fact that they are enterprising enough to have one.

Howbeit, whether or not heroic measures of this sort are advisable, — resulting in a saving to astronomical science of from seventy-five thousand to a hundred thousand dollars a year,

an amount which might be jointly contributed by the several governments to the maintenance of mountain observatories, directed by an international commission, or of an international computing bureau for the complete utilization of the masses of observations accumulating the world over, and for the encouragement of research in theoretic astronomy, — it is certain that the deliberations of such a congress could not fail to advise governmental co-operation in the preparation of the nautical almanacs now existing. National pride aside, and this might be done in a multitude of ways, most prominently in the case of the preparation of the data relating to the moon. Take, for example, the hourly lunar ephemeris and the lunar distances as printed each year in the British nautical almanac and the American ephemeris. These data occupy about one-third of the entire number of pages of each of these publications; they are now prepared independently by the two offices, but are, when printed, substantially identical in both; and, further, the work being done at about the same time in the two countries, the results of the one do not serve any sufficient purpose as a check upon the accuracy of the other. The cost of this part of the almanac alone to each nation amounts to several thousand dollars annually, — an amount which might be reduced one-half by the preparation of these data conjointly, to say nothing of other immediate and favorable results which might be secured by such co-operation.

We should not like, however, to give the impression that this had never been thought of before, nor indeed that steps had never been taken toward securing such co-operation. It is frequently the best policy to let well enough alone; and we do not fail to recognize the fact that it is very often wise to leave a thing as it is, just because it has always been so: in fact, we are conservatives ourselves, though not that precise type of conservative, which, as we speak of the moon, recalls Douglas Jerrold's characterization as one who would "refuse to go out when there's a new moon; and all out of love and respect for that 'ancient institution' — the old one." The wisest conservatism would appear to suggest the annual publication by the nations conjointly of a single volume of astronomical predictions, which, in addition to other improvements, should combine all those desirable features not dependent upon individual meridians, and which in some degree characterize all the astronomical ephemerides of the several governments. The contents and arrangement of the articles of such an ephemeris could only be determined by an international conference. While this may be little better than mere speculation, any one who has the four principal ephemerides in constant use will readily recognize how small a portion of each is employed, and, with extended interpolation-tables, how little the inconvenience of using the ideal ephemeris solely would be.

THE GEOGRAPHICAL WORK OF THE GREELY EXPEDITION.

THE general features of the geographical work of the Lady Franklin Bay expedition may be of interest to the readers of *Science*, in connection with the map furnished through the courtesy of Capt. J. R. Bartlett, chief hydrographer U. S. navy. The details are reproduced from photographs of charts made at Fort Conger by the late First Lieutenant James B. Lockwood, U. S. army, of his and my work.

The expedition fitted out by the war department under the supervision of Gen. W. B. Hazen, chief signal-officer, and commanded by me, left St. Johns, Newfoundland, July 7, 1881. After a remarkably successful voyage, the party landed on the shores of Discovery Harbor, just south of Robeson's Channel. The station called Fort Conger was in latitude 81° 44′ north, longitude 64° 45′ west. The site was the same as that occupied by the stores landed from the English ship Discovery, of the Nares expedition, 1875–76. During the autumn, as much work as possible was done towards establishing depots for use of exploring-parties the following spring. The sun, returning after an absence of one hundred and thirty-five days, found the party well and in good spirits. Parties were immediately put into the field to establish advance depots; and

Drawn by Fred. D. Owen.
Published February 1885 at the Hydrographic Office, Navy Department, Washington, D.C.
J.R. Bartlett, Commander, U.S.N., Hydrographer to the Bureau of Navigation.

shortly after, two main exploring-parties left the station.

The party under Acting assistant surgeon O. Pavy, U. S. army, which attempted a northing direct from Cape Joseph Henry, failed even to reach the 83d parallel, owing to disruption of the polar pack north of Grinnell Land.

Lieut. James B. Lockwood was ordered to explore the north coast of Greenland. Leaving Fort Conger, April 3, 1882, he crossed Robeson's Channel from Cape Beechy to Cape Sumner, where the main depot of provisions had been established. From that point across Brevoort Peninsula to Repulse Harbor, and thence along the shores of the polar ocean to Cape Bryant, he was supported by three parties of men hauling Hudson-Bay sledges. From Cape Bryant, Lieut. Lockwood and Sergeant Brainard, with Eskimo Christiansen and dog-team, travelled direct across Sherard Osborn Fiord to Cape Britannia. Midway between these capes a sounding was made, but no bottom reached at eight hundred feet. Rounding Cape Britannia Island, which was the farthest point seen even by their English predecessors, they pushed on to the eastward, and later to the north-east, until, on May 15, 1882, Lockwood Island was reached. Its assigned latitude, 83° 24′ north, was the mean of sets of circum-meridian and sub-polar observations. Its longitude was 40° 45′ west. To the north-eastward, land was yet seen, the farthest point being about 83° 35′ north, 38° west. To the south and east, only a confused mass of rounded, snow-covered mountains was visible. The entire coast was rugged and precipitous in the extreme. Strangely enough, but one glacier was observed, although the interior of the country was wholly snow-clad or ice-capped. Along the coast, stretching from headland to headland, was found a tidal crack, which appeared to mark the line of separation between the embayed ice and the paleocrystic pack. In the deep fiords along the coast were seen only level expanses of deep snow, devoid of heavy hummocks or marked ice-foot. In returning, the same route was followed; and on June 3 the party reached Fort Conger in good condition, with the exception of snow-blindness contracted in the last two days' travel.

In April, 1882, with three men, dragging a Hudson-Bay sledge, I succeeded in penetrating into the interior of Grinnell Land. Starting from Fort Conger, we travelled south-westward to Sun Bay, and, passing Miller Island, discovered that we were in a fiord (Chandler Fiord) which terminated to the south-westward in a bay. Passing up the north arm of the fiord, a river was reached, having its source in a glacial lake of great extent. Crossing the lake (Lake Hazen), the farthest point reached was Henrietta Nesmith glacier. The party returned by the same route.

In June, with a party of four men, I succeeded in reaching the east end of Lake Hazen by an overland route. Following that lake to the west, Very River was reached; and following up that valley with one man, I alone attained the summit of Mount Arthur on July 4. From the top of that mountain North Grinnell Land stretched out before me. An enormous ice-cap covered the smooth-topped mountains to the northward of the Garfield and Conger ranges, through the gorges of which numerous and magnificent glaciers pushed southward. To the north-westward the trend of the mountain range indicated its connection with Challenger Mountains of Aldrich, and that the western polar ocean was not far distant.

In 1883 Lieut. Lockwood's attempt to reach the northern point of Greenland was unsuccessful, owing to open water at Black-Horn Cliffs. In consequence, I sent him, on his return, to attempt the crossing of Grinnell Land to the western sea. Accompanied by Sergeant Brainard and a dog-team, he travelled down Archer Fiord, and thence westward *via* Beatrix Bay. They succeeded in reaching Greely Fiord, and followed it some distance westward. From a high mountain, the northern shore appeared to terminate in Cape Brainard, while to the south-west very high land was seen at Cape Lockwood. This land, apparently separated from Grinnell Land, was named Arthur Land.' The remarkable feature of this trip was the appearance of the southern ice-cap of Grinnell Land. It presented an average perpendicular front of one hundred and fifty feet.[1]

As regards Grinnell Land, the southerly trend of coast at Aldrich's farthest, the position of Cape Brainard, and the general trend of the land seen by me from Mount Arthur, indicate that the western coast runs quite directly from Cape Alfred Ernest to Cape Brainard.

It is to be noted that Cape Lockwood of Arthur Land is nearer to Lindsay Island and North Cornwall of Belcher than to Fort Conger, our own station.

The considerable extension of Hayes Sound to the westward, by Sergeant Long's journey from Sabine, leaves but a scant hundred miles between its north-westerly point and Cape Lockwood, and but a little farther to the south-

[1] The height of this ice-cap was given at fifteen feet in *Science* of July 25, 1884.

west reaches the waters of Jones Sound in their northern extensions.

The importance of the northern work is not confined, as many think, to the mere planting of the American flag a few miles nearer the northern axis of the globe than has floated the standard of any other nation. Lockwood's journey has gone very far towards settling the much-vexed geographical question, the configuration and northern extension of Greenland. The farthest point seen is scarcely three hundred miles from the land of Lambert, sighted on the east coast in 1670, and less than four hundred and twenty-five from the most northern point of Koldeway and Payer. Of the forty-seven degrees of longitude between Fort Conger and Cape Bismarck, but twenty remain unknown. I venture the opinion that future voyages will confirm the indications growing out of our discoveries, that Arthur Land is separated from Grinnell Land by a fiord or channel connecting the western polar ocean with Hayes Sound. I also think that the northern coast-lines of the Parry Archipelago will be found trending gradually in a north-easterly direction, and terminating in Arthur Land. On these points, as well as on the remarkably fertile belt of iceless country found by me in the interior of Grinnell Land, such as Nordenskiöld hoped to find in Greenland, I trust soon to dwell at length in a forthcoming narrative.

A. W. GREELY, *Lieut. U. S. army.*

THE CONFIGURATION OF GRINNELL LAND AND ELLESMERE LAND.

THE discoveries of the Greely expedition on the west shore of Grinnell Land are most valuable and important, as there was a vast field for conjecture concerning the configuration of the coast-line of this large island. The exploration of the north shore by Lieut. Aldrich of Nares' expedition proved the improbability of any great extension to the west. The discovery of the west shore at so short a distance as Lieut. Lockwood found it, was, however, quite unexpected. From the description of Hayes Sound, obtained by Dr. Bessels from the Smith-Sound natives, and from information and drawings I received last summer during my stay on Davis Strait from natives who had crossed Lancaster and Jones Sound, and lived on Ellesmere Land, it is possible to learn something more about this long and unexplored coast.

The most exact description I received was from an Eskimo woman whom I met at Cape Kater. She was born at Igluling in Fury and Hecla Strait, had lived some time in Repulse Bay, returned to Igluling, and afterwards crossed the land to Admiralty Inlet, which the natives call 'Tudnunirossirn.' There she lived for a number of years; and about fifteen years ago she started with a party to North Devon, which the Eskimo call 'Tudjan.' There is little intercourse between Baffin Land and North Devon, Lancaster Sound being seldom covered by a solid ice-floe. The north shore of Baffin Land ('Weevang' of the natives) is generally washed by water during the whole winter.

Crossing the sound on sledges, these Eskimo passed a very small island, most probably the rock seen by Capt. Adams in 1871, and in two or three days reached the opposite shore. They did not follow the shores of North Devon, but crossed the ice-covered island on sledges. In four days they reached the north shore, whence a long and narrow peninsula, Nedlung, stretches to Ellesmere Land (their 'Oomingmam nuna,' i.e., musk-ox land). Through the narrow passage dividing Tudjan from Nedlung runs a very strong tidal current, which keeps open a water-hole throughout the winter. All around this place the ice wastes quickly in the spring, and forms a large basin of water abounding with seals. Only that part of the peninsula which lies nearest to North Devon is high and steep, and forms a bold face: farther north it is very low. The length of Nedlung may be about forty miles; its width, three or four miles. West of it there are numerous small islands, called 'Kikkertakdjuin:' to the east there are no islands.

Having reached Oomingmam nuna, the Eskimo fell in with a small tribe residing on this shore. Here they lived for some time, as an abundance of seals was found during the whole year. Farther north-west there is a large fiord, called 'Kangirtuksiak,' off which an island is found, Kikkertakadlinang. The Eskimo did not go to the land on the other side of the fiord, as polar bears are said to be very numerous and large there.

I obtained this information by most careful and minute investigation on every point. I also heard some less detailed descriptions of the journey to Oomingmam nuna by natives of Ponds Bay, who had not been there themselves, but had heard about it from their ancestors; and I may here state that all their traditions and descriptions which I had a chance to verify proved accurate and reliable.

There can be no doubt about the identity of Tudjan and North Devon, as they say that

the land can be seen from Weevang (the north shore of Baffin Land); and many natives have lived there, and have been seen by whalers, and by the expeditions sent in search of Sir John Franklin.

The report on the state of the ice in Jones Sound is very important for the identification of this place. As there is a narrow neck of

land connecting Cornwallis and Bathurst Islands, I was rather inclined to judge this to be the place where my Eskimo had been. However, her memory would barely have failed her in recollecting the passage over the ice of Wellington Channel; and besides, the description of the land, Oomingmam nuna, does not agree with Bathurst Island. In Jones Sound, Belcher found open water in May, 1853, at a time of the year when the ice in narrow channels can only be wasted by strong currents. We know nothing about the part of the sound north-east of North-Kent Island, north of which Belcher discovered many small islands. The open water, the narrow passage between North Kent and North Devon, and the many small islands to the north, closely resemble the description given me by the Eskimo woman. It would be very interesting to find that Jones Sound is closed there by a narrow neck of land. The heavy ice Inglefield met with in Jones Sound, in 1852, may have drifted into the sound as easily from Smith Sound as from a sea west of Ellesmere Land.

The last reason leading me to think that Ellesmere Land and Oomingmam nuna are the same, is that the same name is applied to Ellesmere Land by the Smith-Sound natives. In Etah, Bessels met a man who came from Cape Searle, on Davis Strait. He had lived for some time among the Ellesmere-Land natives, and referred to that country as Oomingmam nuna. In the whole of Baffin Land the natives know Oomingmam nuna, and always point it out as beyond Tudnunirn (Ponds Bay) and Tudjan. For these reasons there can scarcely be any doubt that the description I obtained really refers to Jones Sound and the west shore of Ellesmere Land.

The Eskimo of Etah assert that Hayes Sound is a passage leading into the western ocean, and dividing the land west of the Smith-Sound seas into two islands, — Ellesmere Land and Grinnell Land; and there is no reason to doubt their statements. The English expedition under Nares supposed the sound not to be open to tidal currents; Greely's explorations, however, extend it much farther to the west, and are rather in favor of the theory that the sound really forms a passage. The accompanying map presents my views of the probable configuration of the land in this region. Dr. Franz Boas.

PALENQUE VISITED BY CORTEZ.

A memoir by Mr. Teobert Maler upon the state of Chiapas (Mexico), published in the July and August numbers, 1884, of the *Revue d'ethnographie*, contains some items of more

than ordinary interest. To one of these—his conclusion that Cortez, in his expedition to Honduras, visited Palenque, and found it then inhabited — I call the special attention of the readers of *Science*.

This conclusion is based chiefly upon his study of Cortez' route in his journey southward. He identifies as Palenque the town which Herrera names Titacat, and which, according to Bernal Diaz, was the first reached after the execution of Cuauhtemoctsin, and where Cortez, unable to rest at night, "went into a large apartment where some of the idols were worshipped," missed his way, and fell some 'twelve feet,' receiving a severe wound in the head, and in reference to which Cortez writes as follows: —

> "It is a very beautiful village: it is called Teoticcac, and has fine temples, especially two, in which we are lodged, and from which we have cast out the idols, for which they do not show much regret; for I had already spoken to them of it, and had shown them the error in which they rested, and that there was but one God, creator of all things. . . . I learned of them that one of these two houses, or temples, which was the most important, was sacred to a goddess in whom they placed much confidence and hope, and that they sacrificed to her only young and beautiful maidens. If they were not such, then she would be very angry with them; and for this reason they always took great care to seek them, that she might be satisfied; and they brought up from infancy those who were of good appearance to serve this purpose."

Our author comments on this letter as follows: —

> "This description by Cortez applies perfectly to Palenque. There are, indeed, at this place, besides numerous temples and buildings, two principal edifices. One contains the great hall of mural inscriptions: the other is the convent of the virgin priestesses, which has been wrongly taken until now for the palace of the king."

Is this conclusion justifiable? It has generally been admitted that the route followed must have brought the Spanish conqueror within a few miles of this place: hence the opinion advanced cannot be considered as doing violence to the history of the expedition in this respect. If inhabited at that time, it is not probable that he would have approached within twenty-five or thirty miles without visiting it, as it must have been, during occupancy, a place of considerable notoriety and importance.

Stephens was led by his examinations to believe the ruins of Yucatan were inhabited villages and cities down to a comparatively modern date, some of them being occupied until the conquest by the Spaniards. Charney's explorations led him to the same belief. He remarks in one of his letters published in the *North-American review*, —

> "It is certain, that, at the time of the conquest, the coast of Yucatan and Tabasco was covered with towns, pyramids, and monuments, all of which were inhabited. And if such were the case with the coast, what is the inference that must be drawn as to the interior? . . . If the palaces of Comalcalco were entire and inhabited at the time of the conquest, we may feel bound to conclude those of Palanque were in the same condition. . . . Altogether, it seems to be sufficiently established that these monuments were inhabited at the date of the conquest, and that they are the productions of a comparatively modern era."

And now Maler, who has gone carefully over the ground in person, and studied the country and the ruins for himself and in his own way, comes to precisely the same conclusion. We are therefore convinced that there is nothing in the age of the ruins to forbid the idea that Cortez visited the place, and found it inhabited.

It is also worthy of notice that Charney agrees with Maler in considering Palenque a 'holy place,' a 'religious centre,' and that the so-called 'palace' must have been 'the home of priests, and not of kings.'

Our author's theory will afford at least a partial explanation of some of the figures found on these ruins; as, for example, the frequent representations of children in the arms of males and females, the repeated occurrence of female figures, and the fact, as shown in Stephens's plates, that the heads of most of these are obliterated, which I have long suspected was due to the fanatical zeal of Catholic priests, who visited the place at an early day. Cortez' visit will furnish a complete explanation of this fact, which does not appear to have attracted the attention its importance demands. CYRUS THOMAS.

DO ANIMALS EXCRETE FREE NITROGEN?

MANY of the older experiments upon the nutrition of animals included determinations of the nitrogen of the food and of the visible (solid and liquid) excreta. Almost invariably the latter quantity was notably less than the former, and as a consequence it was commonly held that the difference was excreted in gaseous form through the lungs. In process of time, however, as the methods of experiment were refined, this deficit began to diminish in amount, until now it is indisputably shown that the great difference found by the earlier experimenters was very largely due to mechanical losses of the excreta. A certain insoluble residue, however, still remains, which has been the occasion of not a little contro-

versy among physiologists; one school maintaining, and another denying, that it is to be interpreted as showing an excretion of gaseous nitrogen.

There is one fact which renders the results obtained by the experimental method just mentioned inconclusive either for or against an excretion of free nitrogen: it is that the animal experimented upon may either gain or lose nitrogenous matter from the tissues of its body during the experiment. If the former take place, the excretion of nitrogen is diminished by that amount: if the latter happen, it is increased. But, while such gain or loss of nitrogenous matter by the body may undoubtedly take place, we have no means of proving that a small gain or loss has or has not occurred in any given experiment. If in some trial the nitrogen of the excreta exactly equal that of the food, the advocate of the excretion of gaseous nitrogen can say that a certain (unknown) amount of nitrogen *may* have been lost from the body of the animal, and, by chance, the same amount *may* have been excreted as gas. If an experiment show a deficiency of nitrogen in the excreta, the denier of the excretion of free nitrogen can say that exactly that amount of nitrogen *may* have been gained by the animal. Plainly, neither of these possibilities can be either proved or disproved by this method of experiment.

A resort to an investigation of the respiratory products naturally suggests itself. The experiment, though a difficult one, has been made; but the results have not, as might have been hoped, sufficed to decide the question definitely.

It should be remembered that the amount of nitrogen excreted as gas must, in any case, be small. The large deficit found by the earlier experimenters is universally acknowledged to have been erroneous. Bearing this in mind, it is evident, that, as already pointed out, a single experiment by the first method has comparatively little weight. But very many such experiments have been made, and, when properly made (i.e., on mature animals, with food just sufficient to maintain them without gain or loss of weight), they all agree in showing a very small difference between the nitrogen of the food and that of the excreta; and, moreover, the difference is sometimes in one direction, and sometimes in the other. For example: out of forty-three experiments by various observers, whose results chance to lie before me, nineteen show an excess of nitrogen in the excreta, and twenty-four a deficiency, as compared with the nitrogen of the food. The excess varies from 0.07% to 6% of the total nitrogen fed; and the deficiency from 0.02% to 6.7%. Many more observations might be quoted to the same effect. Such results as these have a cumulative force, and go far to establish the hypothesis that there is no excretion of gaseous nitrogen.

Some of the believers in an excretion of gaseous nitrogen, particularly Seegen and Norwak in Vienna, have attacked these results upon the side of the analytical methods employed, claiming that the process (soda-lime process) used for estimating nitrogen gives too low results. It has been shown, however, by several chemists, that this is not the case when the process is properly performed; while some recent trials by Gruber[1] show, that, when the so-called 'absolute method' for nitrogen is employed, substantially the same results are reached.

The main reliance of those who believe that animals excrete free nitrogen, however, is upon respiration experiments, nearly all of which appear to favor their view. These experiments are made substantially in the following manner. The animal breathes in a confined volume of air of known amount, whose exact composition is determined by analysis before the experiment begins. As the oxygen of the confined air becomes exhausted, measured quantities of pure oxygen are admitted from a gas-holder, while the carbonic acid which is exhaled is absorbed by caustic potash. At the close of the experiment the air in the apparatus is again analyzed; and the observer then proceeds to compute, from the data he has secured, the amount of nitrogen originally present in the air within the apparatus, and the amount remaining at the close of the experiment. If the latter quantity is found to be the larger, it shows (barring experimental errors) that the animal has exhaled gaseous nitrogen.

Almost, if not quite, every experiment made on this plan has shown an apparent small excretion of free nitrogen. Thus the well-known experiments of Regnault and Reiset appear to show an excretion of free nitrogen by various animals. In their experiments with small animals the amount was relatively small; and sometimes an absorption of nitrogen was observed, especially during hunger. In experiments with larger animals (sheep and calves), in a larger apparatus, the apparent excretion was quite considerable.

Seegen and Norwak in Vienna have reported numerous trials with a simplified form of Regnault and Reiset's apparatus, all of which show an apparent excretion of nitrogen; and a lively debate has been carried on between them and Voit, each party endeavoring to explain away the results of the other.

Some recent experiments by Leo[2] are of much interest in this connection. He worked with rabbits, which were tracheotomized and supplied with pure oxygen. After sufficient time had elapsed to remove all free nitrogen from the lungs, the expired gas was collected, and found to contain nitrogen corresponding to an excretion of over 8 mgr. per hour and kilogram of body-weight. This result was obtained when the animals were located in free air. In a second series the head of the animal was cemented into the apparatus. The excretion sank to 2–3 mgr. per hour and kilogram. Finally, in a third series, the whole body of the animal was immersed in a warm bath in order to hinder possible diffusion of atmospheric nitrogen into its cavities, and the excretion was reduced to 0.3–0.5 mgr. per hour and kilogram, or to about one-twelfth the amount found by Seegen and Norwak.

It thus appears that the greater the care taken to

[1] *Zeitschr. für biologie*, xvi. 367.
[2] *Jahresber. thier. chem.*, xi. 382.

exclude atmospheric nitrogen from the apparatus employed, the less becomes the apparent excretion of nitrogen by the animal. This, taken in connection with the similar fact already mentioned, regarding the results of experiments by the other method, is significant. If, as we increase the delicacy of our experimental methods, the apparent excretion of free nitrogen becomes less and less, it is not a very bold assumption which regards it as entirely due to the unavoidable errors of experiment. That such is the case is perhaps not proven, but the weight of evidence is decidedly in favor of that belief.

H. P. ARMSBY.

THE BRITISH NAUTICAL ALMANAC.

WE have received promptly, as usual, the "Nautical almanac and astronomical ephemeris for the year 1888, for the meridian of the Royal observatory at Greenwich," the contents and arrangement of which are announced to be the same generally as those of the preceding year. We find no changes in the adopted astronomical constants, nor have any new prediction-tables been substituted for those which have now been employed for many years. The early Struve constant of aberration is not replaced by the recent Pulkowa determination, and Newcomb's mean equatorial horizontal parallax of the sun, 8.848″, is wisely retained. The fundamental elements of the moon's position in space are derived from Hansen's tables unaltered, and the apparent positions only are modified by Newcomb's corrections, — a method of procedure which seems to be best adapted to the needs of the future investigator.

For the first time in the history of nautical almanacs, the positions of all the great planets were derived from a uniform system of tables, and so published in the British 'Nautical almanac' for 1882; and the use of these same tables is still adhered to. These are the planetary tables constructed by the late Leverrier, and printed in the fifth, sixth, twelfth, and fourteenth volumes of the 'Annales de l'Observatoire impérial de Paris.' The derivation of the times of the phenomena of Jupiter's satellites is based on the 'Tables écliptiques des satellites de Jupiter, par le Baron de Damoiseau,' Paris, 1836. Professor Adams's extension of these tables, now employed in the British 'Nautical almanac,' will expire in two years more.

This ephemeris is now most deficient in its list of standard stars, the number and relative positions of those in the list being entirely inadequate to the needs of field and observatory work. Catalogues of stellar co-ordinates of high precision are now so numerous that there would seem to be no good reason why the British 'Nautical almanac' should hesitate in following the 'Berliner astronomisches jahrbuch,' the 'Connaissance des temps,' and the 'American ephemeris,' all of which have within a few years adopted very full lists of standard stars. Also great improvements might be suggested for other parts of the work.

Ever since the year 1834, when the English 'Nautical almanac' became an astronomical ephemeris as well, the management of this publication has been characterized by a conservatism, which, in these times of change just for change, is delightful to behold. But even conservatism may be unwise; and, if the British 'Nautical almanac,' as an astronomical ephemeris, is to hold in the future the place it has held in the past, a committee of reconstruction, somewhat like that 'relative to the improvement of the Nautical almanac' in 1830, would seem to be required to effect the needed modifications.

DAVID P. TODD.

CONTAGIOUS DISEASES OF DOMESTIC ANIMALS.

THE agricultural department at Washington has just issued a volume of some three hundred and fifty pages devoted to the above subject, as the result of the investigations of its veterinary division, — an office distinct from the more newly established 'bureau of animal industries.' The subject-matter, being made up of the reports of the veterinarian-in-chief and his assistants, is of a sort that will, in a way, be interesting and instructive reading for veterinarians, and to a certain extent for comparative pathologists.

The volume opens with a description of a 'veterinary experimental station' recently located, in connection with the department, near Washington, which seems to afford abundant facility for the proposed work, and from which, in the future, much that will tend greatly to aid in protecting our animal interests from the ravages of disease will undoubtedly result. Then follows a detailed report of outbreaks of contagious pleuro-pneumonia among cattle in Connecticut, New Jersey, Pennsylvania, and Maryland. These have an historical interest, but nothing more, because these states have repeatedly been shown to contain this exotic disease; and it has just as repeatedly been shown that a more or less constant interchange of it goes on with the natural traffic of cattle within their borders.

An exceedingly interesting and carefully written report is made by Dr. Salmon upon an enzoötic outbreak of ergotism among cattle in Coffey county, Kan. It is very much to be regretted, for the sake of the department, the cattle interests of Kansas, and the veterinary profession, that, under the circumstances, Dr. Salmon did not himself attend to the matter when first it was reported to be an outbreak of 'foot and mouth disease,' instead of trusting so important a decision to such an unsafe man as 'V. S.' Trumbower proved to be, who, by his own report of the matter given in this same volume, seems to have arrived upon the ground on the afternoon of March 8, to have examined the cattle and their surroundings carefully, and to have then entertained the opinion that the trouble was due to 'foot and mouth disease,' until the 20th of the same month, when he was joined by Dr. Salmon. He then suddenly became as firmly convinced that the trouble was due to ergotism. Is

the department employing unqualified men in this work?

An examination was made to ascertain whether the hay used in Kansas, Missouri, and Illinois, contained ergot, and it was found that several grasses were badly infected with it; and a plate is given showing infected spikes of wild rye, timothy, red-top, and blue grass. It is stated that the proportion of ergot in some spikes of wild rye was ten or twelve per cent of the weight. A chapter is devoted to the nature, chemical composition, and action of ergot. In this chapter is an account of the ergot fungus (Claviceps purpurea), taken from botanical sources, and a plate is given showing the microscopical characters of the fungus. By some oversight, this plate, which is copied from Tulasne, is said to have been drawn from nature by Marx.

The ten pages devoted to 'investigations of swine-plague' are largely made up of a review of the work of Klein and Pasteur upon the same subject, with an insistence upon Dr. Salmon's claim to priority in the discovery of the organism said to be the cause of the disease. A few additional experiments are given tending to show that the specific cause lies in the action of a micrococcus arranged in pairs; and the statement is made that 'a large number of similar observations have been made,' but they are not detailed.

The main objection to be made to the experiments is to the use of *fluid*-culture media, which may be depended upon to give results, to be sure, but not always such as are satisfactory. Solid nutritive materials are by far the easiest in which to detect impurities; and by their use the study of the life-history of any particular bacterium may be carried out with much greater precision. We are aware that Dr. Salmon objects to the use of solid media, but, so far as we have seen, he has not stated the grounds of his objections.

It is impossible to criticise fairly a summary of results without complete knowledge of the experiments by which they were reached. It is stated that "the first annual report of the Bureau of animal industry, which will contain a detailed statement of the investigations made, . . . will be submitted . . . at the close of the year." We await its publication with interest, in the hope of obtaining that detailed statement free from criticism upon others. A direct and simple statement of work done and observations actually made is the method of real progress in the study of the bacteria. One's critics may be trusted to discover the merits or faults that may exist in comparison with the works of others.

A good translation by Mr. Theobald Smith, of Megnin's recent article on the gape-disease in fowls, and its accompanying parasite, which follows, will be of very general interest, and can be read with great profit by those interested in the general subject in all portions of the country.

A long report of the doings of an international veterinary congress, held at Brussels during September, 1883, by Prof. J. Law, seems rather out of place in the volume, because, of all the subjects considered, only one, 'The organization of a veterinary service,' could properly be brought to the notice of the commissioner of agriculture. It is interesting and instructive as showing how far ahead of us the nations of Europe are, in giving attention to the protection of their animals from disease, and what great resources they have in their state veterinary schools, from which to draw *proper* material for their state veterinary service.

Mr. J. H. Saunders's report of his trip to Europe is chiefly valuable and interesting in connection with information which he was able to gather in France regarding the Percheron horse; and his remarks should be read by those who contemplate making importations of these animals, or of any other breed of French horses. Mr. Saunders went to London, and travelled over the same ground in the veterinary privy-council office that had been gone over by agents of the agricultural department before, and with the same results; viz., our beef animals would be admitted free from the 'slaughtering restrictions' when we could show a clean bill of health, and not before. Also 'foot and mouth disease,' as landed in our cattle there, was contracted on board ship during the voyage, the ship having received the infection from British cattle.

Dr. H. J. Detmers gives a very unsatisfactory report of investigations made by him in Texas, of southern cattle-fever. One of his assertions, not in the least proven, however, is, well — new, to say the least; viz., that the virus of this disease is in the saliva of the southern animal. Such assertions, unless made for good and well-shown reasons, are to be deplored as tending rather to hide, than make clear, the very points for the elucidation of which the whole work was ordered done.

A very able paper upon trichiniasis, by Dr. Salmon, is reprinted from the report of a special commission upon the swine industry of the United States, and added to the volume, which closes with the usual reports from the unprofessional correspondents of the department concerning the general health of all kinds of farm animals throughout the country.

THE COAL QUESTION IN ENGLAND.

The very serious problem of coal-supply has received a thorough review in a recent number of *Nature*. In 1861 the question was considered by Mr. Hull, who estimated that the available coal in Great Britain represented a total amount of 79,843,000,000 tons, which, consumed at the annual rate of 100,000,000 tons, would last about eight centuries. This estimate was later proved to be too high; and in 1871 a commission, appointed to investigate the question, reported that in England there were about 90,207,000,000 tons of coal developed, and about 56,273,000,000 yet unopened, making a total of 146,480,000,000 tons of available coal. Subsequent investigation proved this to be somewhat exaggerated. In these estimates thin seams less than a foot thick are not included,

and the strata are estimated to end at 4,000 feet in depth. Even if they do extend deeper, mining would be impracticable because of the expense; and, besides, the temperature would be 116° F. The deepest coal-pit in England is 2,448 feet, but one in Belgium extends 3,490 feet.

In 1881, 154,000,000 tons were extracted, — enough to build fifty-five great pyramids, or rebuild the great wall of China and add one-quarter to its length. The total amount of coal mined since 1854, would build a column 9 feet 4 inches in diameter, a distance of 240,000 miles, i.e., to the moon. The output shows considerable fluctuation from year to year, — as might be expected from the variety of accidental circumstances, such as new inventions, the mean annual temperature, and the state of trade, — but, on the whole, a very rapid increase; the output for 1875 being double of that for 1854, and that for 1883 double of that for 1862; and, if the amount extracted increases at this rate (3,000,000 tons annually), the supply will be exhausted in the year 2145 A.D. The exhaustion will be theoretical only; for in a comparatively short time the price of coal will increase, and the demand necessarily lessen, so that coal will never be exhausted. One of four things must then happen, — either some new source of energy must be supplied, or a larger per cent of the coal must be utilized, or coal must be imported, or England must give up her manufactories. It is doubtful if any new source of energy on a large scale will be discovered, unless some explosive be used for the purpose. According to Sir William Thomson, energy in the form of electricity can be transferred three hundred miles through a copper rod, with a loss of only twenty per cent: so in this way waterfalls may be utilized in the future.

While it is hardly possible to use less coal, we may get more energy out of it; for at present, out of a theoretical 10,000,000 foot-pounds of work which one pound of coal can supply, we only get 1,000,000 foot-pounds. But instead of a decrease in the waste, there is likely, on the contrary, to be an increase; for each year faster speed is demanded by rail, and steamships are rapidly replacing sailing-vessels. It might be possible to prevent the annual exportation of 22,880,000 tons by export duties; but that does not seem expedient. The idea of importation is hardly practicable, for the nearest coal-mines of any extent are in Canada and the United States. The former are not easy of access, but are almost unlimited; and those in the United States contain at least thirty-eight times as much coal as those in England. To supply England with the necessary coal, 2,100 ships as large as the Faraday, each carrying 6,000 tons and making thirteen trips a year, would be required. The cost would be necessarily greatly increased. In former times, England produced its own breadstuffs: now the greater part is imported. If coal becomes scarce, there will be no way of paying for food, emigration will begin, the death-rate will increase, the birth-rate decrease, and England will change once more to an open, cultivated country, devoid of all other industries.

PREHISTORIC AMERICA.

THIS translation of Nadaillac's 'Prehistoric America,' we are told, is made with the author's sanction; and it is also by his permission that certain portions of the work have been so 'modified and revised' as to bring them "into harmony with the results of recent investigation, and the conclusions of the best authorities on the archaeology of the United States." Speaking in a general way, these changes and additions may be said to be confined almost entirely to the chapters that relate to North America, and to consist, not in the discovery of new truths, although some additional facts are offered, but in the adoption of certain theories, as positive conclusions, which, in the original publication, are given as explanations, more or less probable, of the points at issue. Thus, for instance, in that portion of the work which refers to the origin and antiquity of man in America, we are given to understand that he is probably of Asiatic descent, all other theories being practically ignored. To this explanation, considered simply as such, we do not object. Appearances certainly favor it; and as it is the most satisfactory way of accounting for his presence here, and for certain peculiar features in his civilization, we do not see any reason why it should not be accepted, at least until something better is offered. That his ancestors arrived here at a period so remote that it can only be measured by geological epochs and phases of civilization, is conclusively proved; and though it is not equally susceptible of demonstration, yet we think it highly probable that these immigrants may have started from different centres, and gradually pushing their way westward across Bering Strait, and by way of the Polynesian Islands, may have landed at different times, and at different places, on the shores of both North and South America. That they belonged to different races, and were in different stages of development, is possible; and whilst we are willing to admit that "the culture which can be traced from the shell-heap to the mound, from the mound to the pueblo, and from the pueblo to the structures of Mexico, Central America, and Peru, is distinctively American," we may be pardoned for suggesting that it is possible, in view of what is said of the facilities of intercourse, not only between our tribes but between the continents, that this culture may have been colored by Asiatic influences of a comparatively recent date.

Prehistoric America. By the MARQUIS DE NADAILLAC. Translated by N. D'Anvers. Edited by W. H. Dall. New York, *G. P. Putnam's sons*, 1884. 566 p., illustr. 8°.

In the chapters that relate to the archeology of the Mississippi valley we are fortunately on safer ground. The arts and industries of the recent Indians, as seen in their ornaments and implements, and as described by the early chroniclers, furnish a convenient standard by which to fix the place of the so-called mound-builders in the scale of civilization; and a comparison of these remains with the mounds and their contents enables us to say with certainty that these two peoples, admitting them to have been distinct, had attained to about the same stage of material development. Indeed, the two classes of remains are believed to agree in every essential particular. Not a single specimen has yet been taken from the mounds, that indicates a different phase of civilization from that which the Indian is known to have reached, — nothing which he could not have made, or might not have bought from his neighbors in Mexico or on the Atlantic seaboard. This is certainly an important link in the chain of evidence that points to the identity of the Indians with the mound-builders; and if we add to it the fact that the Indians are admitted to have built both mounds and embankments, and that "they are the only people except the whites, who, so far as we know, have ever held the region in which these remains are found," it will be seen that there is ample ground for the conclusion that the mounds and enclosures of the Mississippi valley, of every sort and size, "were the work of these same Indians, or of their immediate ancestors." All other inferences are denied to us until it can be shown, that, at some time in the past, there lived in this valley a people other than the Indian, who had reached the same or a higher stage of development. To say, as is sometimes done, that such a people may have lived here, — and, for that matter, it is as easy to *suppose* a dozen or two of them as one, — may be very true, but it does not meet the point. Suppositions are neither facts nor arguments; and, unfortunately for the advocates of this theory, the modern school of ethnologists has a decided preference for the last two. Until, then, it can be shown that there lived here, in prehistoric times, some other people, who chipped flints, wove cloth, hammered metals, worked in stone, manufactured pottery, built mounds and earthworks, and did all the other things that the 'red Indians of historic times' can be proved to have done, it will not be necessary to go any farther, or to waste any more time in search of a mound-builder.

In dealing with the architectural and other prehistoric remains of Arizona, Central America, and Peru, the same method of investigation is followed with equally satisfactory results. The cliff-dwellers, considered as a separate and distinct people, with a civilization different from that of the Pueblo Indians, are made to take a place by the side of the mound-builders, in the limbo of exploded theories; the deserted cities of Mexico and Central America are found to be nothing but the abandoned dwellings of a people whose mode of life, as Bandelier well says, "differed from the communal life of the Indians in other regions only by the exigencies of another climate and of varying natural resources;" and the ruined temples, palaces, and fortresses of Peru, stripped of all exaggeration, and measured by the same unfailing standard, are recognized as a striking but legitimate product of the civilization which was in existence there at the time of the conquest, and which, in many of its features, was but a counterpart of that which prevailed in Mexico, and, we may add, in the regions to the east of the Mississippi.

This is a brief summary of some of the conclusions reached in the present volume, or which may be deduced from the premises here laid down; and, to those of us who have watched the progress of anthropological studies in this country for the past few years, it is needless to say that they represent the current scientific opinion of the day. Indeed, it could not well be otherwise, since they are the logical results of the application to American archeology of the method of investigation which has been in use everywhere else, and which is the only one that promises to lead to any thing satisfactory. The old plan of inventing a new civilization, or resurrecting an extinct people by way of accounting for every differently shaped pot that happened to turn up, has been tried, and found wanting; and we have at last adopted a system of classification and comparison that enables us to connote the relations between people and things, to fix their several values, and assign them their relative places in the scale of progress. Squier began the good work many years ago, but failed to carry it to a logical conclusion. When the mantle fell from his shoulders, Morgan picked it up; and, though he sometimes swung the pendulum too far in his direction, yet there can be no doubt as to the tremendous impetus he gave to the study. Following him came the Bureau of ethnology at Washington, the Peabody museum at Cambridge, the Archaeological institute of America, and the Société des Américanistes in Europe; and it is to their systematic exertions in the collec-

tion of data, joined to the individual researches of a band of enthusiastic students abroad, as well as in our own country, that we owe this the best work on prehistoric America that has yet been published.

But whilst we thus gladly bear witness to the merits of this work, we must not forget the marks of carelessness which frequently disfigure its pages. Quotations and references are incorrectly given. Writers whose statements are more than doubtful, are given a prominence which they do not deserve; and there are assertions like the one (p. 82) as to the relative antiquity of the mounds in the Southern States, which needs proof, or that on p. 381, in regard to 'tempering' copper, which may or may not be true, depending on what is meant by the term. Finally, we must protest against the reference (p. 64) to the dogma of transubstantiation. Since that article of belief is held by rather more than half the Christian world, an offensive reference to it by the editor is not only uncalled for, but in excessively bad taste.

[The editor gladly inserts this review, written at his solicitation; but he does so without committing himself to the advocacy of the views therein expressed, which seem to maintain the identity of all peoples that ever inhabited the American continent up to the advent of Europeans. It seems to him that the progress of science demands that this should be looked upon as a question to which investigation may still be directed. While historical evidence, on which the reviewer lays such stress, undoubtedly gives the clew to recent peoples, we must certainly depend on archeological research for the data by which to decide all questions which concern the origin and relationship of those which preceded them.]

A HANDBOOK OF HEALTHY AND DISEASED MEAT.

In Germany there is no need that an official should be ignorant of the duties he has to perform; for, no matter in how restricted a sphere he has to work, there are extended treatises covering the exact points, with which he should be acquainted. In the volume which lies before us, the inspector of meat, or the veterinarian who may be called upon to decide upon the fitness of animal flesh for human food, would find a good practical guide to the work.

The first part of the volume is devoted to a consideration of the morphology and chemistry of meat, with remarks on its general physiology and pathology. Then follow a practical description of the different kinds of food animals, and the various methods of killing, and of cutting up and preserving the flesh. After this is a chapter chiefly devoted to healthy meats and the changes which the different sorts undergo in digestion.

The last half of the book treats of diseased meat and the dangers of its use. In this lies the value of the work; as the special appearances, and the methods for their detection, are given in connection with each disease, as well as the disorders which may arise in man following their use as food, together with the means of prevention. Finally there is appended a digest of the laws of Germany and Austria regulating inspection.

The book is one which can scarcely be said to be of general scientific interest; and, on account of the language in which it is written, it will probably not be widely read by the class of men in this country to whom it would be of the greatest value. From a pecuniary point of view, a translation of such a work would not pay here at present; but from the economic interests which are connected with the subject, and the great protective influence which a well-maintained inspection of meat through our country would exert upon the public health, an edition in English, translated and published under the auspices of the proper department of the national government, would be of great and peculiar interest in the hands of the proper officers of our local boards of health.

Handbuch der fleischkunde. Eine beurtheilungslehre des fleisches unserer schlachtthiere, mit besonderer rücksicht auf die gesundheits pflegedes menschen und die sanitätspolizei. Von Dr. ADOLF SCHMIDT-MÜLHEIM. Leipzig, *Vogel*, 1884. 8°.

THE AMERICAN SOCIETY OF MICROSCOPISTS.

THE American society of microscopists has published the account of the meeting held last August at Rochester. The volume is a neat octavo of nearly three hundred pages, with a few plates, and appears in part as a memorial of the late R. B. Tolles, whose lithographic portrait is prefixed to the titlepage. The portrait is such that its total absence will appear desirable to many. The address of the president, J. D. Cox, is substantially a review of the arrogant and ignorant attacks which Wenham repeated during so many years against Tolles's wide-angle lenses; and the contrast between

Proceedings of the American society of microscopists. Seventh annual meeting. Buffalo, *Bigelow bros., pr.*, 1884. 4 + 300 p., [6] pl., illustr. 8°.

the bitter injustice of the English writer and the calm impersonality of the American optician, who was in the right, is skilfully woven into a tribute to Tolles's character. There follows a short appreciative memoir of Mr. Tolles by Dr. George E. Blackham.

The remainder of the volume is occupied by the papers and proceedings, and contains exceedingly little original matter. There are articles which repeat in detail perfectly familiar modes of work, and others which deal with those vague and worthless generalities of commonplace which characterize half knowledge. Of the latter, the essay by Dr. J. Redding is a too perfect example. It is on the extra-vascular circulation, and is largely formed of commonplaces, the rest being half truths and total errors. For example: Dr. Redding says (pp. 85, 86), "Bile, gastric juice, in fact all of the so-called secretions, together with the worn-out and effete tissue-detritus, are the result of physical disintegration of the outermost substance of the cells." What can one do to help the author? Perhaps print the whole sentence in italics, to point out the parts of it which are erroneous. We find, however, several articles of real interest. Some new appliances for convenient work are described. Gundlach's suggestion of a new method of construction for objectives of low power, with increased angular aperture, by changing the crown glass of an achromatic lens, and adapting the flint glass to it, is noteworthy, and may lead to a valuable improvement. Attention should also be called to the very deserved criticism, by Edward Bausch, of the English 'society screw,' which is every thing save a good standard. It is much to be regretted that the volume contains so very little of results of original research.

THURSTON'S METALLIC ALLOYS.

IN this volume are brought together the results of the author's work[1] on metallic alloys, with an introductory chapter on the history and characteristics of metals and their alloys, which is in the main the same as that to part ii., and two chapters, one containing an enumeration of the uses of the non-ferrous metals, and a statement of the location and reduction of their various ores; and the other, interesting descriptions of the newer methods of working hot and cold metals.

The scientific value of the experiments, whose record and discussion constitute the principal features of the book, and which were confined to the mechanical properties of commercial copper, tin, zinc, and their alloys, — attention being chiefly given to the strength and elasticity of these alloys when subjected to tensile, compressive, bending, and twisting forces, — is diminished by the failure to exercise due care in the preparation of the alloys. The need of great care in this matter is recognized and emphasized by investigators, for most alloys exhibit phenomena of liquation; that is, they tend, when melted and about to solidify, to separate into their constituent metals, or into several masses composed of different alloys. Special precautions with respect to purity of the metals, rate of cooling, oxidation, temperature during melting, frequency of agitation, etc., must therefore be taken, if the resultant solidified mass is to be homogeneous.

Professor Thurston is fully aware of this liability to liquation; but on "assuming charge of a series of experiments on the characteristics of alloys, and an investigation of the laws of combination," the duty assigned him by the U. S. board, we find him holding the following view of the work: —

"The intention in the work here to be described was, not to determine the character of chemically pure metals, melted, cast, and cooled with special precaution, but to ascertain the practical value of commercial metals, as found in the markets of the United States, melted in the way that such alloys are prepared in every foundry for business purposes, and cast and otherwise treated in every respect as the brass-founder usually handles his work; and to determine what is the practical value to the brass-founder and to the constructor of commercial metals, treated in the ordinary manner, and without any special precaution or any peculiar treatment."

The book will be acceptable to the engineering public; for, besides the author's own work, it contains the views and results of other investigators, extensive tables on the physical and mechanical properties of bronzes and brasses, and Bolley's compilation of the technically useful alloys, the author increasing this rich collection still further by recipes from French and American sources. The determination and topographical representation of 'the strongest of the bronzes' will also be found of decided interest.

The materials of engineering. Part iii. *Non-ferrous metals and alloys.* By Prof. R. H. THURSTON. New York, *Wiley*, 1884. 14+575 p., illustr. 8°.

[1] Reports of U. S. board to test iron and steel, etc., vol. i. 1878, and vol. ii. 1881.

THE PRINCIPLES OF CHEMISTRY.

To most persons, and indeed to most chemists, chemistry is the science which has to deal only with the composition of bodies. No one can doubt the prime importance of the science regarded from this stand-point; but it may fairly be asked whether the determination of the composition of bodies is the final object of chemistry, even if by composition we mean not only the kinds of matter of which the bodies are made up, but the arrangement of their smallest particles.

The determination of composition in this broad sense forms the principal work of the chemists of the present generation, and of many generations past. In a rough way, to be sure, attempts have been made to discover the laws which govern the changes in composition which bodies undergo, but our knowledge of these laws is as yet extremely limited. It is the discovery of these laws which forms the highest object of chemistry. It is one thing to know, that, when hydrogen and oxygen are brought together under certain circumstances, water is formed, and that under certain other circumstances water can be decomposed into hydrogen and oxygen. It is another thing to know something about what takes place in the interval between the disappearance of the hydrogen and oxygen and the formation of the water, or *vice versa*. We have here to deal with a natural phenomenon, which should be studied as other natural phenomena are studied; as, for example, the falling of bodies, etc. Suppose that in studying the falling of a body we should confine our attention to the body at rest before it falls, and after it has fallen, how extremely imperfect our knowledge of the phenomenon would be! It is plain that we could never discover the laws of falling bodies by such observations; and yet our observations in the case of chemical phenomena are almost exclusively of this kind. The reason is, that chemical action usually takes place so rapidly that it is practically impossible to make accurate observations during its progress. Of late, however, there has been a marked tendency to the study of the course of chemical reactions; and the indications are clear that chemists are beginning to give the subject of chemical action as such more serious attention than has heretofore been the case.

The book before us has largely to deal with the recent developments in the scientific study of chemical phenomena, and with well-known facts and hypotheses which have a bearing upon the deeper problems of chemistry. In his zeal for the new work, the author is perhaps now and then unfair towards the old; but in general he gives evidence of a spirit of fairness, and a desire to weigh conscientiously the facts and the inferences which they seem to permit. As regards the subjects treated in the book, we quote from the preface: —

> "The book is divided into two parts. The first part is occupied with the statement and discussion of the atomic and molecular theory, and the applications thereof to such subjects as allotropy, isomerism, and the classification of elements and compounds. Somewhat full accounts are also given, in this part, of thermal, optical, and other departments of physical chemistry, in so far as the results and methods of these branches of the science are applicable to the questions regarding the composition of chemical systems which are connoted by the term 'chemical statics.'
>
> "The second part of the book is devoted to the subjects of dissociation, chemical change and equilibrium, chemical affinity, and the relations between chemical action and the distribution of the energy of the changing system. These and cognate questions I have ventured to summarize in the expression 'chemical kinetics.'"

The first part gives us a clear treatment of the subjects of atoms and molecules, and the structure of molecules. The chief characteristic of the author's method of treatment is an absence of dogmatism, and a clear determination to be governed by facts, and not by hypotheses. We commend this part of the book to advanced students of chemistry who have become contaminated with the dogmatic methods which are so much in vogue. We earnestly beg our teachers to study it, and, if possible, to profit by it.

In the second part of the book are found chapters on subjects which are not commonly treated in text-books of chemistry. The researches of Guldberg and Waage, and of Ostwald, of Pfaundler, Horstman, and Willard Gibbs, are fully and clearly treated for the first time in a chemical text-book in the English language, and treated in such a way as to convey a correct idea in regard to the relations of the various investigations to the general problems of chemistry. The chapter on affinity is worthy of special mention and of special study.

It may be questioned whether, in his views regarding valence and structure, the author does not allow himself to be carried too far. Thus, p. 463, we read, —

> "When . . . we do not know the molecular weights of compounds in the state of gas, conclusions regarding the structure of the molecules of these compounds are very apt to degenerate into

A treatise on the principles of chemistry. By M. M. PATTISON MUIR, M.A., F.R.S.E., fellow and praelector in chemistry of Gonville and Caius college, Cambridge. Cambridge, *University press*, 1884. 24+488 p. 8°.

mere exercises of the fancy. Indeed, the use of the expression 'structure of molecules' is in such cases quite unwarranted."

There is undoubtedly a sense in which the last statement is true, but there is another sense in which it is not true. We may know a great deal about the chemical conduct of a compound, — enough, indeed, to warrant us in partially expressing its structure in a formula, without positively knowing its molecular weight. The reason why "conclusions regarding the structure of the molecules . . . are very apt to degenerate into mere exercises of the fancy," is not so much that the molecular weights are unknown, but rather that the true signification of structural formulas is not understood, and formulas are frequently constructed on an entirely inadequate basis of facts.

Taken all in all, the book is deserving of the highest praise, and its influence can only be beneficial. It will arouse opposition, but it will at least cause those who oppose it to think; and, if it should do this, it would be of value, though every word were false.

NOTES AND NEWS.

MR. H. L. BIXBY of Chelsea, Vt., is taking steps to introduce a system of weather warnings throughout his state by means of blasts from factory-whistles. The signals are as follows: after the first long, unbroken blast, usually given at about seven A.M., a single five-second blast indicates fair or probably fair weather for the day; two blasts, foul weather; three, fair changing to foul; four, foul changing to fair; five, doubtful or irregularly variable. After any of these, five short blasts signify a cold wave or unseasonable frosts. The managers of the *Free press* at Burlington undertake to send the necessary telegrams on payment of a small fee. Randolph is the first town to adopt the system: the signals are regularly given there now from a ten-inch steam-whistle.

— Herr J. Brautlecht has been experimenting on the transfer of bacteria from the soil to the atmosphere. Ignited sand, gravelly soil, and a moderately clayey garden-soil, were moistened with liquid containing bacteria, and covered with glass bells. In a few hours microbia of the same kind as those contained in the liquid were found in great numbers in the moisture condensed on the sides of the bell. It will be remembered that Angus Smith was one of the first to point out that aqueous vapor condensed on the walls of rooms contains micro-organisms.

— The Nitrate owners' committee of Tarapaca have determined to offer a prize of a thousand pounds for the best essay on the employment of nitrate in agriculture, so as to supplant other fertilizers. The essay is to be published by the committee in all modern languages. Moreover, five hundred tons of nitrate, subscribed by the manufacturers, are to be shipped to Europe and the United States, to be employed in experiments at the expense of the committee. A fund of four thousand pounds has been formed to carry out these various schemes, the object of which is to promote a demand for the nitrate.

— Dr. Edward Divers, principal of the Imperial engineering college of Tokio, Japan, writes to the *Chemical news*, informing the editor of a serious accident which threatens to deprive him of the sight of one eye. He is anxious to put chemists and others on their guard. A bottle containing phosphorus trichloride had done duty for many years as a specimen for the lecture-table. Dr. Divers was carefully warming the neck of the bottle to liberate the stopper, when the bottle burst in pieces with great violence, the cornea and iris of the right eye being extensively wounded, and the aqueous humor discharged.

— A sensation has been caused in Australia by the discovery of the gold-field at Mount Morgan, near Rockhampton, in Queensland. The mine, it is estimated, contains gold enough to yield, after working, a profit of nine million pounds. The curious fact is that the locality is not one which a geologist would have pointed out as likely to contain gold. The theory put forward to account for the presence of gold there is that it is a secondary formation. The gold is not in the original matrix. Nature has already mined it, chemically treated it, sublimated it, and redeposited it. The discovery is likely to give a stimulus to 'prospecting' in Queensland, and also in the other colonies.

— Professor Woldrich, at a recent meeting of the Vienna anthropological society, read a paper on the latest prehistoric remains found at Prerau. Several cartloads of bones had been found there while workmen were levelling for an orchard, and taken to the Olmütz museum. They were principally bones of mammoths, cave-bears, foxes, hares, etc.; but mingled with them were flint weapons, and some of the bones bore traces of being worked and cut. Charcoal was also found in the surrounding earth.

— The board of commissioners in charge of the lights on the coast of Scotland suggest that in cases of fog, when a light cannot reach its usual distance, the beam from a powerful source, such as electricity, might be depressed so as to concentrate the intensity on the near-hand sea by slightly moving the flame out of the focus of the apparatus, and supplementing it by the use of suitable reflectors. They also look upon the question of the relative absorption of electric light by fogs, compared with that of light from other sources, as yet-undetermined, and requiring strict investigation.

— The brewers' journal, published in Nuremberg, the *Allgemeine brauer- und hopfenzeitung*, celebrates its twenty-fifth anniversary by offering prizes for two essays on, 1°, The culture of hops; 2°, Barley as brewing-material: the best essay to receive a prize of fifty pounds; the essay, in German, to be sent in to the editor before May 1, 1886.

— The effect of magnets upon artificially incubated hen's eggs formed the subject of some very interesting experiments, of which an account was given by Professor Carlo Naggiorani in a recent paper before the Academy dei lincei. During the hatching-process he kept one set of eggs under the influence of powerful magnets, while another set was incubated away from all such influence. Cases of arrested development were very numerous among the first set, and after birth the rate of death among these was four times as great as in the naturally incubated chickens. Only six chickens out of a hundred and fourteen eggs arrived at maturity. Of these, two were cocks of a splendid stature, and endowed with an insatiable reproductive appetite. With the four pullets the case was quite the reverse. One of these never laid at all, and the three others generally produced very minute eggs without yolks, without germinal spot, and, in a word, sterile.

— An experiment is being tried in the Jefferson physical laboratory, which promises to be successful. An ordinary seconds clock, with a wooden pendulum, is controlled by the signals from the Harvard college observatory, with no other mechanism than a fine spring connecting the pendulum to the armature of a telegraph instrument in the circuit. If the signals are interrupted during the day or night, the error of the clock, which seldom exceeds half a second in that time, will generally be rectified within an hour of their recurrence. The rate is in no way affected by the irregular signals caused in storms by the interference of the wires, and the regular impulses conveyed at intervals of two seconds increase but slightly the swing of the pendulum. The attachment can easily be made to any seconds clock at the cost of a few dollars, and may be of interest to those intolerant of the rates charged by companies for the use of electric dials.

— Aside from the munificent charities of the Salem East India marine society, extending over an unbroken period of eighty-six years, there is a scientific history covering a less extended period, which at this late day is by many persons forgotten, and to the younger generation is unknown. One visible result of this scientific work, although incidental to the more important objects for which the society was formed, is the rare ethnological collections now in the custody of the Peabody academy of science. When the museum was transferred to the trustees of the academy in 1867, such old catalogues and manuscripts accompanied the specimens as were supposed to relate to the collections. These were laid aside for a time, and forgotten. An examination of the various papers referred to, clearly shows that an earnest spirit of scientific research pervaded the early work of this society. The act of incorporation places charitable objects of the society first, and 'the promotion of a knowledge of navigation' second: the museum followed as incidental to the latter. Upon the foundation of the society, blank journals were immediately distributed, under the by-laws, to "every member bound to sea, . . . in which he shall enter the occurrences of his voyage, and particularly his observations of the variations of the compass, bearings and distances of capes and headlands, of the latitude and longitude of ports, islands, rocks and shoals, and of soundings, tide and currents, and on his return shall return the same for the use of the society." This latter clause was in reality meant for the benefit of the commercial interests of the country, which at that time largely centred in Salem. Many of the journals are beautiful examples of neatness and fine penmanship, and are embellished here and there with diagrams, maps, drawings of coasts, and even with sketches of native craft.

— The 'age of horn' is a term applied by Mr. G. Kaiser to the period of certain relics which he has found in his investigations of the Forel and Cortaillod stations on Lake Neuenburg in Switzerland, where he has been excavating under the auspices of the historical society of Neuenburg. The *Neue Zürcher zeitung* of Jan. 15 states that he found a stratum at a depth of from 1.20 m. to 1.30 m., which contained various horn objects, — such as amulets, cups, knives, daggers, mattocks, rings, buttons, bracelets, shield-studs, etc., — all of which were engraved either with dots or with straight lines; and he concludes that they are older than the bronze or stone implements found in similar localities. But some implement, presumably of stone or metal, must have been employed in cutting the horn; and certainly a single find hardly gives ground for such a wide generalization.

— Two important expeditions are now in progress by Russian travellers, — that of Prjevalski in northern Thibet, in part to discover the sources of the Yellow River; and that of Potanin to north-western China and south-eastern Mongolia. A large number of barometrical observations have been taken, which are to be worked up by Col. Scharnhorst.

— A full account by Lieut. Gordon, of the proceedings of the Hudson-Bay exploring expedition of 1884, with a track-chart of the steamer Neptune, and a report on the geology, etc., of the district visited, by Dr. Robert Bell, who accompanied the expedition in the interests of the Geological survey of Canada, have just been published in an appendix to the annual report of the Canadian department of marine.

— Among recent deaths we note the following: Professor Lauritz Esmark, director of the zoölogical museum of the university of Christiania, at Christiania, in December, 1884; Searles V. Wood, geologist and paleontologist, at London, Dec. 19; Dr. Philipp von Jolly, physicist, at Munich, Dec. 24, in his seventy-fifth year; Rev. James Buller of New Zealand; Alexander Murray, director of the geological survey of Newfoundland; Alfred Tylor, anthropologist and geologist, at London, Dec. 31; Dr. Friedrich von Stein, professor of zoölogy in the university of Prague, at Prague, Jan. 9, in his sixty-seventh year; Major-Gen. K. Sonklar von Instädten, at Innsbruck, Jan. 10; Dupuy de Lôme, engineer at Paris, Feb. 1, at the age of sixty-eight; E. H. von Baumhauer, secretary of the Société hollandaise des sciences; E. C. Rye, librarian of the London geographical society, Feb. 7, aged fifty-two; and S. G. Thomas, metallurgist at Paris, Feb. 1, aged thirty-four.

— At a united meeting of the Victoria and New South Wales geographical societies it was resolved that they should in future call themselves 'The Australian geographic conference,' for the purpose of discussing (periodically) important matters affecting the interest of geographic science of Australia. The governments of Victoria and New South Wales have each placed a thousand pounds at the disposal of the general society, and it is intended in the first place to undertake a thorough exploration of New Guinea.

— The emperor of Germany has conferred the 'Ordre pour le mérite' for science and arts on Sir Joseph Lister. Commenting on this recognition of an English surgeon whose name has furnished a new verb to the German language since the beneficent results obtained by his antiseptic method during the Franco-German war, the *Lancet* observes, "Not only is Sir Joseph Lister to be congratulated on this act of the venerable and most illustrious emperor, but the profession of the United Kingdom will recognize in the act a generous recognition of the claims of British medical science, which, it is only fair to say, is not new on the part of Germany. The discoverer of vaccination has been more honored in Germany than in his own country, in accordance with the scripture that 'cannot be broken.' The quiet evolution in surgery, involving the practical abolition of pyaemia, hospital erysipelas, and gangrene, and an infinite diminution in the calamities of surgery, which we owe to Sir Joseph Lister more than to any other single man, is a service to mankind not quite on the same scale as the discovery of vaccination, but of very far-reaching consequence. Through the slightly discordant notes of diplomacy it is refreshing to notice the harmony of international grace in the higher regions of science and of humanity."

— Some interesting experiments, according to the Journal of the Iron and steel institute, have recently been made for the purpose of determining the respective values of wet and dry coal for the evaporation of water. The results showed that small coal, containing eighteen per cent of water, and nine and nine-tenths per cent of coal-dust, evaporated five and seven-tenths pounds of water per pound of fuel; while the same amount of coal, containing three per cent of water, evaporated from eight to eight and a half pounds of water per pound of fuel. The figures showed that the employment of wet coal gave rise to a loss of from fifteen to twenty-five per cent.

— The programme for the Sheffield scientific school lectures to mechanics for 1885 is as follows: Feb. 12, Norway and the midnight sun, Rev. Dr. C. C. Tiffany; Feb. 17, Science and the supernatural, Professor DuBois; Feb. 19, The present commercial crisis, Mr. A. T. Hadley; Feb. 24, The Asiatic cholera, Professor Brewer; Feb. 26, The sensation of color, Professor Hastings; March 3, Cobwebs, Mr. J. H. Emerton; March 5, Lafayette, Prof. A. M. Wheeler; March 10, The patent law of the United States, Professor Robinson; March 12, Commemoration of the birthday of Bishop Berkeley, President Porter; March 17, The surface life of the Gulf Stream, Professor Verrill; March 19, Map projection, Professor Phillips; March 24, An hour at the Louvre, Prof. D. Cady Eaton. This course has now been in existence twenty years. A fee of one dollar is charged, that the audiences may be the better controlled.

— Sir John Lawes suggests (*Health*) that it will be more profitable to throw sewage into the sea than to apply it to the land. His grounds for saying this are that it will supply the enormous quantities of phosphate of lime, potash, and nitrogen which are necessary to the existence of fishes, but which exist in the sea only in small quantities. Tons of these compounds are taken from the ocean each year in our fisheries without due return. If, then, enough or more than enough to make up for that annually taken out could be returned to the sea in the form of sewage, there is little doubt that increased prosperity may accrue to the fisheries. Even after defecation, much of the nitrogen and mineral constituents would remain; and, indeed, this defecation, or else greater dilution, is absolutely necessary, in order to prevent the destructive work which sewage naturally does in absorbing the oxygen which is necessary to the existence of fishes.

— From the Journal of the Iron and steel institute we learn that Mr. Fayol concludes, from his experiments reported in the *Comptes rendus* of the Société de l'industrie minérale, that the rise of temperature accompanying the absorption of atmospheric oxygen by finely powdered coal is the chief cause of its spontaneous combustion. He finds that only a low temperature is needed to ignite powdered coal; lignite igniting at 150° C., and anthracite at 300° C., and the ordinary varieties of coal at intermediate temperatures. The avidity with which the oxygen is absorbed increases with the rise of temperature, which finally becomes sufficiently high for ignition. An important part in spontaneous combustion has been ascribed by many authorities to finely divided pyrites. The author, however, on subjecting this mineral to the same experimental conditions as the coal specimens, found a less energetic action of the atmosphere. When gradually heated up to 200° C., pyrites and coal behaved exactly alike till a temperature of 135° C. was reached: from this point the temperature of the pyrites remained the same, while the coal-powder rapidly became hotter till the igniting-point was reached.

— Dr. Harrison Allen has republished in a neat pamphlet (Philadelphia, *Blakiston*) his essay on the palategraph, a new and ingenious instrument of his own design, by which the motions of the soft palate may be recorded. The instrument is a straight rod eight inches long, which is passed into the nose so that one end rests upon the upper surface of the palate; just in front of the nose a wire loop encloses the rod, the wire being suspended from a band passed around the head; the loop acts as a fulcrum, so that, when the palate is raised, the free end of the rod moves down, and these movements are recorded upon a paper moved by clockwork (*kymographion*). The

fact that the soft palate is raised during articulation, swallowing, and coughing, can thus be readily demonstrated, and the length of its periods of ascent and descent measured. The palate is seen to be raised once only for some words, twice for others, three times for others. The numbers of these motions are invariable within a narrow range of individual variation. The instrument offers a ready means of detecting paralysis of the soft palate; and it has been suggested that it may be made available for the comparative study of phonetics, for the instruction of the deaf, and for the formation of a system of logography. One curious result we select to mention from the many details of the paper: less motion of the palate occurs in saying 'mamma' than 'papa.' Dr. Allen suggests that the smaller effort required may be one cause of children usually learning the former word first. Like all Dr. Allen's work, this also is excellent.

— In the series of manuals of technology edited by Professor Ayrton and Dr. Wormell, and published by Messrs. Cassell & Co., will soon be published a work on watch and clock making, prepared by Mr. David Glasgow, the vice-president of the British horological institute.

— We understand that *Papilio*, which was removed a year ago from New York to Philadelphia with a change of editor, is now practically to return to New York, as it is to be merged into the Bulletin of the Brooklyn entomological club. Both these names will be dropped at the close of the seventh volume of the Bulletin, in April next, and a new series commenced under the title of 'Entomologica *sic* Americana,' a monthly journal of twenty pages.

— The Journal of the Iron and steel institute sums up the known distribution of iron ore in north-west Africa as follows: "In Morocco there are beds of hematite of considerable size, and their continuity and re-appearance westwards is now an ascertained fact. Commencing from the Tunisian frontier, the Mediterranean seaboard offers an abundance of payable ore at various points, and these deposits were very extensively worked by the Romans, forming indeed their main supply. The most productive Algerian mines furnish a spathic carbonate containing sixty per cent of ferrous oxide, and a hematite containing ninety-two per cent of ferric oxide. The composition of the Algerian ore is exceedingly uniform, and it is almost entirely free from sulphur and phosphorus. These beds re-appear as far west as the confines of the provinces of Rihamina and Dukkala in South Morocco. The deposits consist of red hematite, and show an outcrop of very extensive area. Specimens brought from the Sahara caravan route either to Tafilelt or Timbuctoo prove the re-appearance of these iron-ore beds south of the Atlas ranges."

— The Brookville (Ind.) society of natural history proposes soon to issue a bulletin containing articles, by members of the society, on the natural history of south-eastern Indiana. Mr. W. H. Fogel of West Columbia, W. Va., has presented the society a large collection of archeological specimens, including one of the finest series of hematite implements in the United States. The society is continuing this winter the courses of free lectures, devoted to scientific subjects of popular interest, which it has formerly supported. The second of these lectures, on the ancient vegetation of the globe, was given by Joseph F. James of Cincinnati, on Jan. 13; and the third, on poisons, by Mr. J. U. Lloyd of Cincinnati, on Feb. 3.

— Mr. J. J. Thomson is to succeed Lord Rayleigh as professor of physics at the university of Cambridge.

— Mr. D'Arcy W. Thompson, formerly of Trinity college, Cambridge, has been elected professor of biology in University college of Dundee.

— With the number for 1885, the management of the *Neues jahrbuch für mineralogie, geologie, und palaeontologie* passes into the hands of M. Bauer of Marburg, W. Dames of Berlin, and Th. Liebisch of Königsberg.

— The modern mathematician finds the space of three dimensions, in which our visible universe is contained, entirely too contracted for his conceptions, and is obliged to imagine a space of n dimensions in order that his fancy may find room to disport itself. But it is a new idea, on the part of the novelist, to make the conceptions of transcendental geometry the basis for an amusing story. 'Flatland, a romance of many dimensions, by A. Square' (Boston, *Roberts brothers*, 1885), is in substance a description of life as a geometer might imagine it to be in space of one, two, or n dimensions. Readers of 'Alice behind the looking-glass' will not fail to notice the resemblance of the present work to that singular play of fancy. Curiously enough, a 'scientific romance' on the fourth dimension is just now announced in England by C. H. Hinton.

— A new application of the electric light, devised and used by W. E. Waters of Orange, N.J., is an improvement on the old style of illumination in the astronomical observatory. It consists of a small incandescent lamp-bulb, about three-quarters of an inch in diameter, placed in the end of a cylindrical hard-rubber handle, four inches long, with a push-button on the side. A flexible wire cord connects the apparatus with the battery-wires, and enables the operator to carry this 'electric lantern' about in the hand, ready for use at any moment. This lamp has been used by Mr. Waters about two years, and has proved entirely satisfactory.

— It is announced that Mr. William Cameron, who has given much time to the exploration of Malayan countries, has just prepared at Singapore, on a scale of half an inch to the mile, a large and elaborate map of districts recently explored by him in Selangor, Ulu Selangor, Sungei Ujong, and other parts of the Malay peninsula.

— Dr. R. Neuhauss, a young German physician, has returned to Berlin after extensive explorations among the South-Sea Islands, and has read a report of his researches before the Berlin anthropological society. Part of his ethnological collection he has presented to the Berlin museum.

SCIENCE.

FRIDAY, MARCH 6, 1885.

COMMENT AND CRITICISM.

THE INCREASED favor with which the orogenic theory of earthquakes — the theory that regards earthquakes as the effect of disturbances due to mountain growth — has been looked upon in recent years must be accounted a distinct gain for physical geology. The volcanic theory, now rationally limited, has long been more popular. It is not long since Mallet, who has been widely quoted as an authority on the question, committed himself to the narrow statement that "an earthquake in a non-volcanic region may, in fact, be viewed as an uncompleted effort to establish a volcano," although he afterwards held a broader opinion. Lyell wrote in the last edition of his 'Principles' (1876), very much as in his first (1830), that "the principal causes of the volcano and the earthquake are to a great extent the same, and connected with the development of heat and chemical action at various depths in the interior of the globe." More lately, Daubrée maintains a similar view, even after referring to the suggestions of Dana, Suess, and Heim, and concludes that "earthquakes seem to be like stifled eruptions which do not find an outlet, about as Dolomieu thought."

One of the chief reasons for exaggerating the value of the volcanic to the neglect of the orogenic theory has been the improper reading of earthquake maps. The map constructed by Mallet in 1858, still the best of its kind, is very commonly quoted as showing a general agreement in the distribution of volcanoes and earthquakes; but it is quite unwarrantable to include the well-shaken regions of Spain or the Alps, for example, in the volcanic district of the Mediterranean. The shocks of demonstrably volcanic origin seldom extend far from their centres: the eruptions of Italy do not disturb the adjacent countries. In the Alps themselves there is now no volcanic action whatever, nor has there been any of significant extent at any time in their geological history, so far as it is known. It is altogether gratuitous to suppose that the frequent tremors felt there result from concealed volcanic explosions; for they find sufficient explanation in the forces that have made the mountains, which are undoubtedly still growing.

Another cause for the former neglect of the orogenic theory was the almost universal belief that mountain ranges had been lifted up or burst out by expansive force from beneath, instead of squeezed and crushed together by lateral compression, as is now widely accepted. The difference has been concisely expressed by Stur of Vienna: formerly it was 'gebirgshub;' now it is 'gebirgsschub.' Of course, as long as geologists were generally of the mind that mountains were produced by uplift from beneath, it was natural to associate surface shocks with smothered volcanic action, whether eruptions followed or not; but, with the disappearance of the idea of uplift as applied to mountain ranges, it is as natural to refer earth-tremors in non-volcanic mountain regions to the crushing forces that produce the disordered mountain structure. There is, indeed, now sometimes seen a disposition to go, perhaps, too far in this reaction, and exclude volcanic action from nearly all share in causing earthquakes. Some of the English observers in Japan, a volcanic region *par excellence*, are of this mind, and attribute the numerous small shocks, even there, to structural and not to volcanic disturbance. It is a difficult matter to decide. Indeed, the study of earthquakes must, in great part, long remain in a two-thirds condition. Observations are plentiful, hypotheses have never been lacking; but verification can hardly ever be attained.

THE LACK OF final and convincing verification

of hypothetical views has, however, not prevented attempts at the prediction of earthquakes, and the earthquake prophet must have his mention. Falb, an Austrian, figured in this *rôle* some years ago with such apparent success as to inspire an Italian admirer to compose a sonnet beginning

'O uom, che non puoi tu?'

More recently, Capt. Delaunay of the French marine artillery, and evidently a very different man from the eminent mathematician of the same name, made something of a stir by his predictions. In spite of severe criticisms from Faye and Daubrée, he persisted in maintaining that the Krakatoa outburst resulted from the conjunction of Jupiter and the swarm of August meteors, as he had foreseen it would. Worse than this, he announces a more violent 'seismic tempest' in 1886.3, when the malevolent Saturn lends a hand; and colonists in Java are reported to be troubled thereby! Another method of forecasting is discovered by Mr. Charles Zenger, who finds that electric and magnetic storms, aurorae, tempests, earthquakes, and volcanic eruptions, — all, simply enough, result from a single cause, whose cycle agrees with a semi-rotation of the sun. Nothing of this would be worthy of mention, had it not soberly appeared in the *Comptes rendus* of the French academy of sciences, where it is airily entered under the heading of 'meteorology.'

A BILL IS TO BE introduced into the legislature of Massachusetts to regulate the practice of medicine. It is framed closely upon those already in force in several states in the union, such as Illinois, West Virginia, Alabama, North Carolina (Ohio, Maine, Pennsylvania, and Texas have bills under consideration), and provides for a board of medical examiners who shall not be connected with any medical school. They are to be appointed by the governor, and their function will be to issue licenses to practise medicine or dentistry, on the basis of a diploma from some legally organized medical college, or of ten years' practice, or of an examination of an elementary and practical character in anatomy, surgery, chemistry, pathology, obstetrics, and dentistry. After July, 1886, *all* candidates are to be examined. This board is to be endowed with legal powers sufficient to carry out the purposes of this act.

It will be noticed that this bill is not framed in the interests of any so-called 'school' or 'pathy,' and contains no allusion, direct or indirect, to points in dispute between such schools. The necessity of some such bill in the interests, not of medical science, but of ordinary decency and humanity, is probably hardly appreciated by more than a small fraction of the community, even of the more intelligent portions. One often hears expressions used implying that the user supposes that a diploma confers the right to practise medicine, while the fact is that nothing of the sort is necessary. The privilege of giving (or selling) medical advice to one's neighbor is regarded by the state of Massachusetts as one of the most fundamental and inalienable of rights, and on a par with "the right to life, liberty, and the pursuit of happiness." The only medical function for which this state legally demands even the pretence of a medical education is the signing of certificates of insanity. The practice of medicine, surgery, and obstetrics, with the right to sign certificates of death, may be legally assumed by any horse-car driver who some cold day feels that his profession demands too much personal exposure, steps from his platform, puts up his sign with an 'M.D.,' and waits for patients. If he publicly calls himself a doctor, he is legally one; and, if he escapes a suit for malpractice, the law cannot touch him.

This bill can hardly be objected to as too strict by any physicians, except of the class just described, or those immediately above it, or, on the other hand, by that portion of the community drawn from all social ranks who consider education as a positive drawback, and medical knowledge as a heaven-born inspiration. Most persons, however, who patronize

this class of practitioners do so out of pure ignorance, and they have a right to ask that the law shall give them some protection against too gross imposition. Those who object that this bill imposes the very minimum of qualification (and any who know how brief a study and how limited knowledge a diploma from a 'legally qualified medical college' may testify to, will be very apt to make this criticism) may be reminded that beginnings must be small; that the public is not yet educated in this intelligent state of Massachusetts to believe that the ignorant patients are entitled to any protection, or that the ignorant doctors are not entitled to the same recognition as any other business-man pursuing his calling under the disadvantages of the lack of early education.

It will be noticed that after 1886 the board will examine *all* applicants; and, although it cannot purify as much as might be desirable the present body medical, yet it can then guard the gates against future intrusions of ignoramuses. The strength of different 'schools' of medicine will undoubtedly compel some distasteful associations upon the board of examiners; but the importance of the interests to be served ought to stifle jealousies, and override etiquette. Purification of the profession can but tend to its unification and to the development of the truth. If we can be assured of a competent knowledge of the fundamental medical sciences in all who undertake to practise it, mere 'pathies' and fads must inevitably die out within the profession, and outside of it can have little practical weight.

JUDGING FROM what the honorary curator of the insect-collections of the national museum writes in to-day's issue, there is no important difference between his views and those to whose words he has objected. All agree that collections of insects need vigilant and unremitting care, and that any museum which does not guarantee that care is no fit depository of valuable collections. The question whether the national museum practically offers such guaranty is a nice one. Judging from the past history of the national collections in general, one would unhesitatingly say it did not. Judging, further, from Mr. Riley's own statements of the present condition of things, the same answer may fairly be given; for a large and growing collection, already one of the most important in the country, with no person in charge, or working under direction, whose services the museum can *command*, is plainly not a place which has any right to invite the deposit of unique objects. Notwithstanding this, the recent growth of the museum gives large, one is tempted to say abundant, hope that what has been accomplished means not only permanence, but progress; that, dependent as it is absolutely upon annual congressional appropriations, these will not entirely fail, since its hold upon both popular and congressional favor is such as to command respect and a certain amount of support. Though it may suffer temporary curtailment at times, it is already too strong to suffer long neglect or to be overthrown.

Nor must we forget that it shows hereby its very right to exist. In no country, more than in a republic, have institutions been more severely subjected to the law of 'the survival of the fittest.' With rare exceptions, all the scientific bureaus of the government are dependent for very life, from year to year, on the will of the people. The coast-survey even, with its extensive corps of picked men and all its refinement of work, unsurpassed by that of any similar body elsewhere, exists by virtue of an annual appropriation. However foreign this may be to the administrative ideas of European nations, it is thoroughly ingrained in our policy, a piece of the unwritten law of the land, a substantial part of democratic life. If through its agency the scientific bureaus of our government have reached their present status, and their work has received such generous praise abroad, even to self-reproach, to what may we not look forward when we consider that they have gained their present standing through the

action of an undying universal law which places before them two alternatives, — progress or death!

But to return to the practical question, whether the national museum is a fit place for the present deposit of unique collections of perishable objects, we may say, that, while the future of the museum seems to be assured, we have no sufficient historical ground for belief, that it will reach stability without serious lapses; and that until it supports a competent salaried chief of its entomological department, with at least one paid assistant, it stands in no position to invite the donation, or to warrant the purchase, of a single valuable collection of such perishable objects as insects. That the time will come when it is properly equipped, we cannot doubt; that it should reach it through the sacrifice of Mr. Riley's, or of any other choice collection, would be a burning shame: this is the immediate risk.

LETTERS TO THE EDITOR.

⁎⁎⁎ Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The voice of serpents.

PROF. C. H. HITCHCOCK's note in No. 104 brings to mind a fact noted in my laboratory, which may be of interest to herpetologists. In the autumn of 1883 a friend brought to me two magnificent living specimens of the common prairie bull snake, Pituophis Sayi. I gave them the freedom of my lecture-room, and they soon made themselves perfectly at home.

One day, while working with a large induction-coil, I bethought me of my snakes, and caught the larger (his length was about five feet), and passed a powerful charge of electricity through his spinal column. As the circuit was broken and made, I was much surprised to hear a faint though perfectly distinct cry from his snakeship. My notes made at the time speak of this sound as similar to the voice of a young puppy.

During a period of a month or more, this experiment was repeated with one or the other of these serpents, and always with this cry of pain or anger.

H. H. NICHOLSON.

University of Nebraska, Feb. 18.

The collection of insects in the national museum.

In reference to my remarks on the above-named subject, your explanation, that you meant 'the perpetual care of valuable collections' (p. 25), meets my criticism; and there would be no need to recur to the subject, were it not for Professor Fernald's communication on the same page. He there says, "The national museum has appointed an honorary curator, but it might as well be without one as to have one whose entire time is occupied elsewhere." Professor Fernald speaks here without knowledge, and under misapprehension of the facts. The honorary curatorship of insects is not 'worse than useless,' and the curator's time is not wholly 'occupied elsewhere.'

The organic law (Revised statutes, § 5586; Statutes forty-fifth congress, third session, chap. 182, p. 394) authorizes the director of the national museum to claim any collections made by other departments of the government. The national museum has a substantial fire-proof building, and a stable administration. The department of agriculture has a tinder-box, and the administration shares the uncertain influence of politics. Yet connected with the practical entomological work of the department of agriculture, there is much museum work proper; and since 1881, with the approval of the commissioner of agriculture, I have, as U. S. entomologist, looked upon material accumulated for the latter institution as belonging to the former, and have freely given my own time, and that of my assistants when necessary, to the entomological work devolving on the curator of said national museum. The two positions are naturally linked.

I am familiar with most of the insect-collections of the country, and believe, that, during the past three years, more original material has been collected expressly for the national museum, and more has been mounted for it, than for any other institution, not excepting the Agassiz museum at Cambridge, with its excellent insect department under Dr. Hagen; while, including the collection of the department of agriculture, and my own (which is deposited in the museum, and will be donated whenever such donation is justified), there has been by far more biographic work done for it than for any other museum. Even in the Micro-lepidoptera, it is probably next in extent to that of Professor Fernald. The care of museum material is of a twofold nature. The preservation of valuable type-collections requires vigilance, but little labor. The less labor, in some instances, bestowed upon them, the better; at least, so I thought last summer in witnessing the overhauling and re-labelling of Grote's collection in the British museum. The preservation and classification of original material, on the contrary, requires brains, time, and means.

The future and perpetual care of an entomological museum cannot be absolutely guaranteed without endowment; but appropriation to a government institution, though depending on the annual action of congress, is probably the next best security. Hence I agree with all *Science* has said as to the need of proper and substantial provision for such future care of the insect department of the museum. Washington is fast becoming the chief natural-history centre of the country; and the national museum is making rapid strides toward justifying its name, and offers, on the whole, as secure a repository for collections as any other institution. I speak of the museum as it is to-day, and not as it has been. The misapprehension indicated, whether an outgrowth of the amount of natural-history material that has gone to rack and ruin here in the past in other departments as well as in entomology, or a result of present rivalry, is certainly not justified to-day.

Professor Fernald truly remarks that "many museum officials have very little appreciation of the vast amount of labor, care, skill, and knowledge required" to properly manage a large and varied insect-collection. Things are too often valued by their size, and the pygmy bugs have not outgrown popular

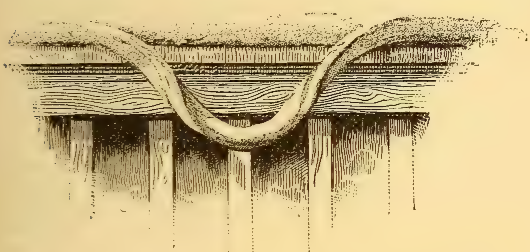
contempt. The tail of a whale is no wise more complicated structurally, nor a whit more interesting morphologically, than the sting of a bee; but it occupies an infinitely greater space, and is more obvious both to the gaze of the curious and the study of the competent, — a fact which the management of a popular museum cannot afford to ignore.

The national museum has very properly developed most in those departments, like ichthyology, geology, and ethnology, which receive, independently, government aid, and thus furnish both workers and material. If some of the other departments have so far been left without material support, those persons feel least like complaining who are familiar with the ultimate intentions of the director and his efficient assistant, and with the vast amount of work accomplished in organization and installation since the building was completed. C. V. RILEY,
Hon. curator of insects, U.S.N.M.

Washington, D.C., Feb. 12.

Plastic snow.

A phenomenon new to me was observed at the close of the north-east storm this noon, which showed the cohesive force in wet snow. The railing to my porch has a top sloping about ten degrees each way. My attention was directed to a festoon of snow sixteen inches and a half between ends, and seven inches deep, formed from a snow-ribbon. As it left the railing, it was gradually twisted, so that the bottom of the loop was in a position the exact reverse of what it had held when upon the rail. The twist-



ing-force had extended for a number of inches in each direction in the part that remained upon the rail. This loop hung free, and moved over an arc of five or six degrees when the wind struck it. It was of short duration, as the water from the rail melted the centre; and the ends, as they swung back, were broken off about four inches from the rail, and showed a spiral twist like that in a twist-drill. On the next panel was the end of a former loop; and this hung free, and measured nearly ten inches in length. EDWARD H. WILLIAMS, Jun.

Bethlehem, Penn., Feb. 16.

Hereditary malformation.

Mr. E. Brabrook writes to the society of anthropology in Paris an account of hereditary hypospadias, first reported to the *Lancet* by Dr. Lingard. The order of inheritance is as follows: first generation, one affected; second, one; third, one, whose widow afterwards married a man unaffected. This woman had seven sons — three by her first husband, and four by her second husband — all affected. I will divide these seven sons into the first and second set. Of the first three, one died childless: the other two had six sons, all affected. Of the second set were born eleven sons, — four affected, and seven unaffected. Three sons are reported of the first set in the next or sixth generation, two of whom are affected; while, of three sons belonging to the second set in the same generation, none are affected. Aside from the great value of such a compact series of well-authenticated facts, a very interesting question, often mooted among stock-breeders, of the permanence in the effects of first impregnations, receives here a partial answer. The running-out of this influence in a few generations should also be carefully studied. I do not speak of the transmission of hereditary traits of the male through the mother, because Dr. Lingard does not seem to have looked among the female descendants for co-ordinated malformations. OTIS T. MASON.

The Georgia wonder-girl and her lessons.

I read with no little interest the article with this title which appeared in this journal on Feb. 6.

I was privileged to make a private examination of Miss Lulu Hurst, the person referred to in the article, on several occasions, in the presence of her parents, and usually of her business-manager. On one occasion I was permitted to make a careful examination of the subject's physical development, and take notes upon her normal temperature, heart-beat, and respiration. I found her to be a healthy, intelligent country-girl, *plump* rather than muscular, presenting nothing very unusual in her constitution; and I certainly did not note the fact that I might be shaking hands with a 'giant.' The muscles of her arm and fore-arm were *not* unusually developed; nor did they stand out prominently, as they do in muscular subjects of either sex. She is above the average stature for women, but does not strike one as being either exceedingly active in movement or overpowerful in frame; as to the former, rather the reverse, I think.

Of the experiment with the staff, I shall simply state that in my case, on two occasions, the staff gyrated rapidly about its long axis, obliging me to quit my hold. This was observed by other persons present during the experiment. In the test with the hat, Miss Lulu stands before you with her hands extended horizontally, palms up, with the little fingers and sides touching each other. On the surface thus presented we place our hat, with the outer aspect of the crown resting on the two palms. The experimenter is then invited to lift the hat off. When I tried this experiment, the hat was only removed after considerable force was exerted, and then came away with a crackling noise, as if charged with electricity. That Professor Newcomb's explanation would not account for the result here, I would say that I knelt in such a position that my eyes were but a short distance away; and my line of vision was in the same plane with the opposed palmar surfaces and the crown of the hat. This latter was of very light Manila straw, with the outer periphery of the crown rounded. Now, as the form of this surface was a broad ellipse, with a major axis of perhaps seven inches, and a minor axis of six, quite smooth, it would be simply an impossible feat for Miss Lulu to seize it when the distance between the inner margins of the opposite thenar eminences in a right line is less than six inches.

Permit me now to present a test which Professor Newcomb did not witness. It consisted in standing upright, with one foot in advance of the other to act as a brace, and holding in the hands with a firm grasp an ordinary chair. This is to be done by seizing it at the rear uprights, about where the back joins the bottom; the former being towards you, and parallel with your anterior chest-wall, against which you

place your elbows at a convenient distance apart. This position evidently leaves a space between your chest and the back of the chair equal in length to your fore-arms, which are extended horizontally. Miss Lulu now takes a position beside you, and, holding her body back, simply places the palmar surface of her hand on the back of the chair on the side towards your body. After a few moments she seems to make the effort to detach her hand from the chair, which latter you are privileged to push forwards. The force at work, however, is too strong for you, and both yourself and the chair are carried backwards, without her hand having changed its position. The chair being a cane-backed one, it is evident that she could in no way gain a hold upon it, and the back of her hand never could come in contact with your chest, as the spanning of such a distance would at once be detected.

Professor Newcomb's conclusions, after having witnessed the test of lifting a chair with some one sitting in it, are to me far from satisfactory. I saw the girl lean over an ordinary chair, with a man weighing over two hundred pounds sitting in it, and placing the palmar surfaces of her hands on the outer sides of the rear uprights near their middles, and *without any* contraction of the muscles of the arm or fore-arm, or increase of pulse (remained at 80) or respiratory effort, or change of countenance due to exertion, so far lift that chair and its heavy contents from the floor as to compel the latter to get out of it; and this without fracturing any of the bones of her upper extremities, or the sides of the chair. The simplest computation will prove that the *lateral pressure* required must be enormous in order to get a hold, and prevent such a weight absolutely slipping between her hands when the upward force comes to be exerted.

R. W. SHUFELDT, U.S.A.

Fort Wingate, New Mexico, Feb. 19.

THE MICROSCOPE IN GEOLOGY.

MANY persons have heard that the microscope, everywhere recognized as indispensable in the investigation of organic nature, has also recently been made use of in geology; but very few have any distinct notion of the sort of problems to which it can there be applied, or of the way in which it can contribute toward their solution. The determination of the different minerals which compose very fine grained rocks may doubtless appear, even to many geologists who have been accustomed to deal with only great areas and mountain masses, a matter of small importance; and they often fail to see that the methods which render such a determination possible, are capable, if properly employed, of throwing much light on some of the most difficult questions with which they have to deal.

The microscopic study of rock-sections is one of difficulty, and indeed quite discouraging to a beginner who attempts it without proper guidance, no matter how familiar he may be with mineralogy, or with the use of the microscope in other fields of research. This fact, coupled with the newness of the branch, sufficiently accounts for the number of workers in it still being so small in this country, which presents unrivalled opportunities for its cultivation.

Although the idea of preparing rocks in transparent sections for the microscope originated with an Englishman, the fruitful line of research to which it gave rise has since been almost exclusively cultivated in Germany. Here the seed fell into soil made already fertile by the labors of older geologists, and sprang at once into a strong and rapid growth. The keen perception and great energy of Zirkel first made known the microscopic appearance of the common rock-forming minerals, as well as discovered the wide distribution of others before considered rarities. Vogelsang, not contented merely to observe, was able to draw from his studies the most suggestive conclusions, which he substantiated by ingenious and delicate experiments. It is, however, to Rosenbusch that the development of petrography as a science is most largely due. In his work, published in 1873, he showed in a masterly manner how what had been learned of the optical properties of different crystals, especially their action on polarized light, could be applied to their identification in thin sections, thus rendering a rigid microscopic diagnosis for the first time possible. From this time on, the interest in this branch of investigation became in Germany very general, and its growth proportionately rapid. The attainment of the long-desired separation of rock constituents, even when of the smallest size, by means of solutions of high specific gravity, and the perfection of many micro-chemical reactions of great precision, followed each other in quick succession, until to-day the accuracy and beauty of petrographical methods are hardly second to those found in any other branch of natural science.

The geologists of other countries on the continent, especially in France and Scandinavia, soon perceived the value of the German work, and early availed themselves of its results to start similar investigations in their own countries. It is a surprising fact that the appreciation of it among English-speaking people has been so slow, that not one reliable text-book on the subject of petrography exists in the language of the man who gave the first impulse to its modern development. Any knowledge of the subject in America is recent, dating from the publication of Zirkel's 'Microscopical petrography' in 1876. How steadily the inter-

est in it is increasing, however, may be judged from the number of American students who have been and still are pursuing it at various German universities. What is needed in this country are well-equipped petrographical laboratories, so that those who are unable to avail themselves of the facilities which Europe affords may not be compelled to remain in ignorance of what is daily becoming a more and more necessary part of a geologist's training. An attempt to organize such a laboratory has recently been made at the Johns Hopkins university and the encouragement which it has already received seems to abundantly justify the experiment.

Heretofore microscopical petrography has been essentially a branch of mineralogy, but its future certainly lies in the far wider sphere of geology. The mere laboratory study of isolated rock-specimens, which has served so good a purpose in the perfecting of delicate and accurate methods, no longer possesses any significance, now that these are so thoroughly developed. What in Germany has been secured by years of patient labor may now be learned in a comparatively short time. Geologists have only to know and realize its application to their field of work, in order to eagerly avail themselves of such an important aid. The use of the microscope alone will in future produce but little that is new; but its possibilities in geology, when intelligently employed in connection with the most detailed and careful field-work, — the necessity of which has been increased, not diminished, by its introduction, — cannot be easily overrated.

What paleontology has done for the fossiliferous deposits, this, and even more, the microscope must do for the crystalline rocks. The less altered forms of igneous masses have thus far been almost exclusively studied; and, although they still have much to teach us, it is not by their investigation that the microscope is destined to yield its greatest assistance to geology. The changes, structural and chemical, which go on in rocks after they are first formed, leave behind them more or less distinct traces which it is the special province of the microscope to follow out and interpret. Of how much has already been learned regarding the alteration of sedimentary rocks near their contact with eruptive masses, the work of Rosenbusch in the Vosges Mountains, of Lossen in the Hartz, and of Hawes in New Hampshire, is abundant proof. The wide-spread changes which rocks subjected to regional metamorphism have undergone, are far more complicated and difficult, but they can undoubtedly be studied with as great success. It is by dealing with such problems as Lossen, Renard, and Lehmann, in Europe, and Wadsworth in this country, have especially pointed out, that the microscope in geology can in future render its best service. The manner in which this can be accomplished is by the patient following, step by step, of unchanged rocks into their most completely altered equivalents, and carefully comparing the condition of each constituent at every point. In this manner the succession of changes which they undergo may be as completely worked out as though we could see the process actually going on before our eyes. The alterations of olivine and enstatite to serpentine, of pyroxene to hornblende, and even the reaction of two minerals upon each other in forming a third of intermediate composition, as shown in the rim of amphibole which surrounds olivine where it is in contact with plagioclase, have all been traced by the microscope through every stage. More recently the effects of pressure exhibited by the bending and breaking of crystals, the disturbing of their optical characters, and the local crushing of the rock constituents, have been carefully studied. This is found almost always to be attended by the formation of new minerals, like albite, zoisite, mica, garnet, etc., whose younger origin is only to be proved by a microscopic investigation. It is impossible to mention here a tithe of what has already been done in this direction, although a beginning has hardly yet been made. What are especially to be desired are detailed studies of many small areas, where the same rock, whether eruptive or sedimentary, can be traced from its original form to its most altered state, and a comparison of the results obtained in each. This Lossen[1] has recently attempted for the southern Hartz, and has thereby indicated what is perhaps the most promising field for microscopic work in geology. GEORGE H. WILLIAMS.

THE SPANISH EARTHQUAKES.[2]

THE Spanish peninsula has been the scene of a series of earthquakes, which, for extended duration and disastrous effects, surpasses any thing that has been felt in that region in recent

[1] Studien an metamorphischen eruptiv- und sedimentgesteinen, erläutert an mikroskopischen bildern. Jahrbuch der preuss. landesanstalt für 1883, p. 619.

[2] In preparing this notice, the following journals have been consulted; viz., Cronica cientifica (Barcelona), Science et nature, La Nature, L'Astronomie, Comptes rendus, Cosmos, Hansa, Nature, and various English and American newspapers.

years. Beginning toward the close of December last, the shocks continued at intervals for more than a month, and, indeed, the ground has hardly yet resumed its wonted stability; while the loss of life and destruction of property, exceeding that of 1829 in Valencia, has perhaps not been equalled since the great Lisbon earthquake of a century ago.

The first light shocks were reported in the early morning of Dec. 22, 1884, at Pontevedra and Vigo on the north-west coast, and were also felt at Lisbon and other places in Portugal, on the island of Madeira and the Azores.

This was followed on the evening of Dec. 25 by disastrous shocks in the southern part of the peninsula. They began at 8.53 P.M., being felt as far north as Madrid, where bells were rung and clocks stopped, but doing no damage there; while in the southern provinces of Andalusia, Granada, and Malaga, where the principal force was expended, hundreds of houses were overthrown, hundreds of lives lost, and some towns and villages entirely destroyed.

VIEW IN A STREET OF ALHAMA, JAN. 3. (From *La Nature.*)

In Cadiz, Seville, Cordova, Jaen, and Almeria the shocks were strongly felt, injuring some buildings, but without serious damage. At Granada, shocks to the number of eight occurred during that night; and, besides other casualties, the front of the cathedral was injured, the Alhambra fortunately escaping harm. The villages of Albuñuelas, Arenas del Rey, Jatar, Zafarraya, and Santa Cruz, were left a mass of ruins. Alhama was destroyed with the loss of over a thousand houses and three hundred and fifty lives. This town consisted of two parts, — an upper and a lower. The upper portion, situated upon the higher ground, was cast down upon the lower, overwhelming it in its fall. The hot springs also ceased to flow for two days, after which, the flow was resumed more abundantly than before. The waters have since then acquired a marked sulphurous character, and their temperature has increased from 47° C. to 50° C.

The province of Malaga also suffered severely. In the city of Malaga all the public buildings were injured, and some were destroyed with many other houses. At Estepona, on the coast west of Malaga, a church and a block of buildings were destroyed. At Torrox, Nerja, Almuñecar, and Motril, places on the Mediterranean Sea east of Malaga, many buildings were overthrown, and many lives lost. In the first-mentioned place, as stated by the alcalde, twenty-six shocks occurred between 8.50 P.M. of the 25th and 11 A.M. of the 26th, completely destroying the village. At Almuñecar twelve shocks occurred in fifteen minutes. At many places where the destruction was less complete, especially at Granada and Malaga, the inhabitants camped for days in the fields and open places, sleeping in tents and sheds, or in carriages, not daring to return to their houses. At Periana, north of Malaga, an extensive land-slip was caused by the earthquake, overwhelming a large part of the town, and destroying a church and seven hundred and fifty houses. Above the village of Guevejar, built upon a hillside, a great parabolic crevasse three kilometres long has opened to a width of from three to fifteen metres; and the village, which rests on a stratum of clay, is slowly sliding downward to the valley, while the houses still remain standing. Some of the houses have moved twenty-seven metres since Dec. 25.

At one extremity of the crevasse a small lake has been formed, having a depth of nine metres, and a superficial area of about two thousand square metres. At another point an olive-tree has been split from root to branches, the two parts remaining upright upon opposite sides of the opening. At still another point, it has divided lengthwise the foundation-wall of a powder-manufactory.

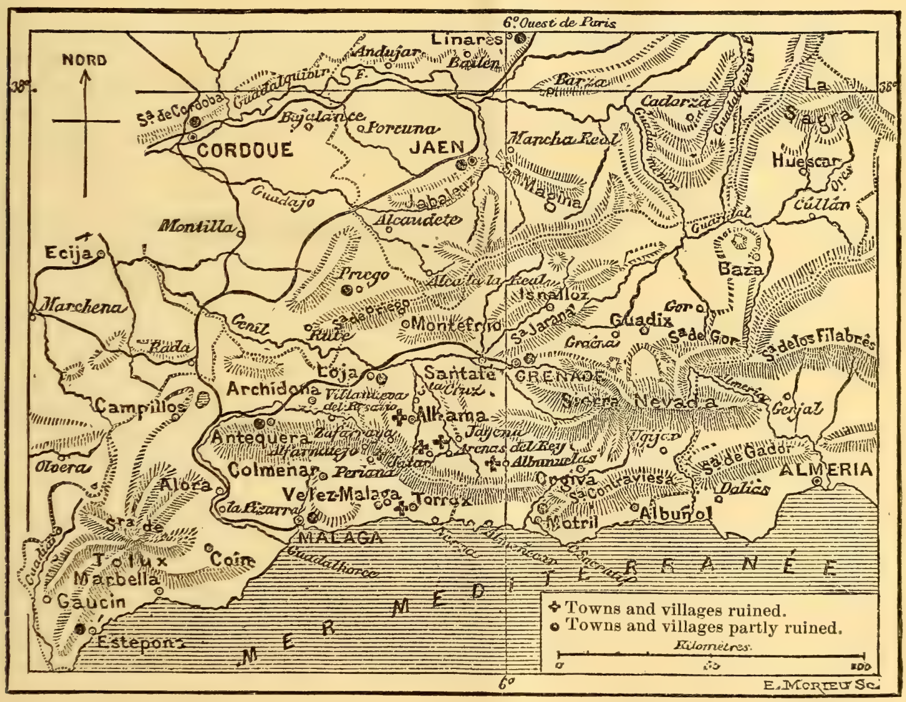
As many of the villages in that part of Spain do not have telegraphic communication with the capital, details have been reported slowly and with considerable uncertainty; and it is difficult to gather from the various accounts any estimate of the whole number of lives lost.

MAP OF SPAIN. THE REGION AFFECTED IS SHADED. (From *La Nature.*)

numbered by thousands, and the villages of Alhama, Santa Cruz, Arenas del Rey, Periana, and Albuñuelas are now but piles of ruins. More than thirty-five villages are named where some dead and wounded were taken from the ruins. Of the 10,000 houses in Malaga, 7,000 will require repairs.

The shock of Dec. 25 was succeeded by lighter shocks on the remaining days of the month, and at longer intervals through the month of January, and, indeed, up to the present time. A list of the shocks is as follows: —

Dec. 22. Pontevedra, Vigo, Lisbon (3.29 A.M.), Madeira, Azores (2.30 A.M.).
24. Seville (light).

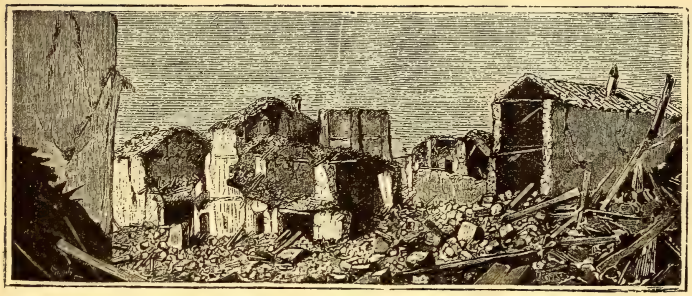


MAP OF THE REGION SUFFERING MOST SEVERELY. (From *L'Astronomie.*)

On Jan. 14 the official records stated for Granada 695 killed and 1,480 injured. Other estimates have placed the entire loss of life at upwards of 2,000. The houses destroyed are

Dec. 25. Madrid (to the Mediterranean, etc., as above).
26. Madrid, Gibraltar, and the southern provinces.

Dec. 27. Antequera (five shocks), Archidona (nine shocks), Malaga.
28, 29. Torrox, Malaga.
30. Velez Malaga, Torrox (7 and 10 A.M.), provinces of Granada and Malaga.
31. Torrox, Granada, Jaen (6.35 P.M.), Malaga.



A RUINED STREET IN ALHAMA. (From *Cosmos*.)

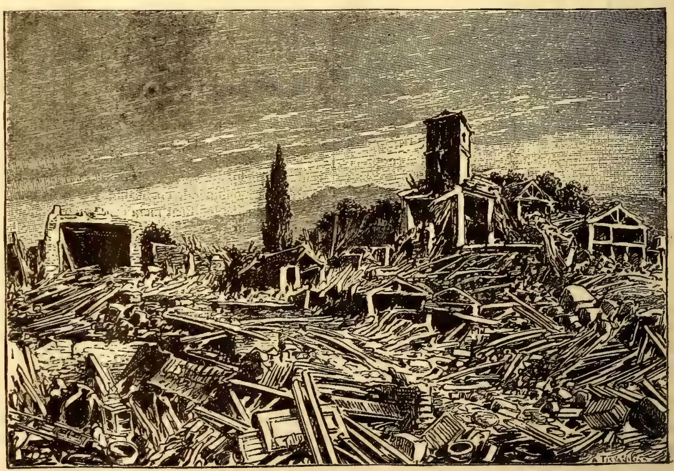
Jan. 1. Torrox, Granada (11.45 P.M.), Malaga, Nerja (2, 6.45, 9 P.M.), Algarrobo, Alhama, Antequera, Valencia.
2. Valencia, Granada, Malaga, Velez Malaga.
3. Loja, Alhama, Jaen, Velez Malaga.
5. Granada (6 P.M., severe), Loja, Motril (fifty houses destroyed), Malaga.
Jan. 7. Nerja, Velez Malaga.
8. Loja, Torrox.
9. Torrox.
10. Malaga.
11. Malaga (buildings fell).
12. Gibraltar, Alhama, Algarrobo.
13. Torrox, Canillas, Almuñecar, Algarrobo.
16. Granada (10 P.M.), Canillas, Motril.
21. Malaga, Loja, Velez Malaga, Almuñecar.
22. Periana.
27. Alhama (one person killed).
Feb. 12. Alhama.
13. Torre del Campo, forty miles north of Granada (serious damage to hospital).
14. Granada, Velez Malaga.
23. Granada (renewed shocks reported).
March 2. Granada, Loja, Alhama (houses fell).

The severe shock on Christmas night seems to have been perceived in England, having been reported as felt at 10.20 P.M. in Wilts, and also having been recorded by small disturbances of the magnets in the Greenwich observatory at 9.15 P.M.; the suspended magnets acting as pendulum seismographs.

While they may probably have no connection with the Spanish earthquake, the following shocks, felt in other parts of Europe during the same period, are worth noting; viz., —

Dec. 25. At Zernetz, Engadine (at 8.17 and 11 P.M., the former hour corresponding to 7.32 P.M., Madrid time).
27, 28. At Tarvis in Carinthia.
28. 7 A.M. at Sundal and Öxendal, Norway.
29. In Wales.
Jan. 4. In Styria.
5. 3 A.M. at Chambéry, Savoy; 5.50 A.M. at Embrun.
Jan. 6. In Italy at Susa, near Mont Cenis, and at Velletri.
21. Between 0 and 1 A.M. at Ennenda, Glarus.

As bearing upon the possible connection between seismic and atmospheric phenomena, it is remarked that an unusually high barometer prevailed over the Spanish peninsula during the first half of December; while from Dec. 20 to 22 a heavy storm area, attended by an unusual atmospheric depression, was passing from north to south over the same region, reaching the Mediterranean on the 22d; also that at Nerja a hurricane followed the first shocks,



RUINS OF A CONVENT, ALBUÑUELAS. (From *La Nature*.)

blowing down the houses, whose walls were already weakened by the earthquake.

The geological characteristics of the country are described in the next article: it will therefore suffice here to say that the seismic phenomena seem to be intimately related to the geological growth of the mountain system, especially the Sierra Nevada, the elevation of which is apparently not yet completed. A commission, consisting of three mining engineers, under the presidency of Sr. D. Manuel Fernandez de Castro, has been appointed by the Spanish government to study this series of earthquakes, and has already distributed a list of thirty-three interrogatories relating not only to the time, direction, and other particulars of the earthquake shocks, but also to various atmospheric phenomena, such as the pressure, temperature, clouds, etc.

C. G. ROCKWOOD, Jun.

THE SIERRA NEVADA OF SPAIN: THE SCENE OF THE RECENT EARTHQUAKES.

THE Sierra Nevada of Spain, though full of interest for the tourist, the man of science, or the student of history, has been little visited, and almost nothing has been written about it.

This sierra forms a compact body, twenty-five miles wide and fifty miles long, completely isolated, and without directly connected lateral spurs or terminal ridges. Surrounded by an alluvial plain as it is, it has, nevertheless, certain smaller neighbors which seem, like itself, to have been ejected from below. Its crest has been denuded by the elements, and its sides scored by brooks or torrents which diverge in all directions from the central axis, fed by the rains of spring and the melting snows of summer. Four principal streams, descending to the north-west, meet at the very foot of the Alhambra, and unite their waters before traversing the renowned plain of La Vega. Their cascades and ripples, descending from the mountain crest above, give to the adjoining valley a delicious freshness during the torrid months of summer. To these waters is due the immense isle of verdure presented by the Vega at a time when nearly all southern Europe is scorched dry by the sun. At many points the rivers run in narrow, deep channels easily dammed. From their sources to the moment when they reach the plain, their average descent is one to ten, almost the maximum for running waters. At that point they are captured: not a drop escapes. All the irrigating works and canals, the customs governing the distribution of water, even the rules recalled by the strokes of the bell nightly from the minarets of the Alhambra, are the legacy of the Arabian civilization which blossomed on the plain before it was driven to a last refuge on the mountain.

On the north, three rivers descend to the plain of Guadiz; but, their sources not being fed by perpetual snows, when the rainy season has passed they dry away. In consequence this plain is as sterile, bare, and forbidding as that of the Vega is green and inviting. Wherever the eye wanders, apart from the sierras, lies a reddish-gray plateau of dusty alluvium, seamed and rent by precipitous cañons. Nothing recalls the idea of life: the desolation is as that of an unknown country, grand and terrible. All the valleys and plains of this part of Andalusia present the same impressive and melancholy features. Gustave Doré, who passed through this region many years ago, has profited by his experience to introduce memories of it in some of the most strange and fantastic productions of his pencil. This sterile region is poor, unpeopled, almost unknown, and practically cut off from communication with the rest of Spain.

Farther to the west is the country of the Alpujarras, so celebrated in Moorish history for the terrible conflicts of which it was the theatre. More than one poet has celebrated the combats of the Christian and the Moor in the narrow defiles and rocky gorges of the sierra; but all these imaginary descriptions fall far short of depicting the scene as it appears in reality.

The Alpujarras are composed of two cistern-like basins, absolutely closed to the outer world, except by two narrow gorges cut in the rock by the rivers which traverse them. The first of these rivers, the Rio Grande de Ujijar, descends directly from the heights of the Sierra Nevada, passes by the site of that town, and, with its affluents, waters the basin of Ujijar, the ancient capital of the little Moorish kingdom. It issues by a deep cañon, and falls into the Mediterranean by the little port of Adra at no great distance. The second, the Guadalfeo, runs between the Sierra Nevada and Contraviesa, close by the former, whose slopes it drains. Emerging from the basin, it turns abruptly to the south, reaching the sea near Motril. Just before entering the gorges of the Sierra Contraviesa, the Guadalfeo receives the brook of Beznar from a point elevated above the plain of La Vega, whence Boabdil, the last of the Moors, is said to have

taken his parting glimpse of his palace of the Alhambra, the rich Vega, and 'Grenada the marvellous.' It is appropriately named 'Suspiro del Moro' ('the Moor's sigh').

A very few men can safely hold the entrances to the Alpujarras; and they long remained the last stronghold of the Arab power in Spain, which has passed, leaving as its memorial little more than the names of a few villages, and the wonderful system of irrigating-works.

There can hardly be a doubt that the series of calamities, hardly closed, which has laid so many villages in ruins since last Christmas, is a continuation of the processes by which portions of the earth's crust are raised in mountain ranges above the rest. A few words on the geological structure of the sierra may indicate the possibilities of the locality. The structure of the sierra and its neighbors is quite simple. They rise like islands or domes of ancient mica schists out of a sea of later formations, which break like waves upon their flanks. These schists are of a silvery white, appearing like snow when distant and illuminated by the sun. They are absolutely sterile, but dip, in a general way, outward from the central axis of elevation in all directions. A belt of radiately dipping Silurian schists encircles the central part of the sierra, which, like the exposed part of the core, assumes rounded outlines, but is succeeded by another belt, rugged, precipitous, and craggy, of Permian limestones, which extends to the base on the eastward, but is nearly as irregular in height as in extent. The Alpujarra basins are excavated in these limestones, and protected by escarped cliffs. Against the base of the sierra, raised slightly near the mountains, but elsewhere horizontal, lie tertiary grits, clayey sands and clays, deposits of fine gypsum, etc., covered with two alluvial series of beds, — the lower composed of decomposition products of the Silurian schists, brought down by water and mingled with material derived from the subjacent tertiary; the upper and later, from the denudation of the fundamental mica schists now forming the crests of the sierras. Moule observes that the elevation of the sierras has, in part at least, taken place since the tertiary epoch, and even since the alluvial period, and that it may not yet have ceased. This observation, written before the recent disturbances, has found in them renewed support.

The people of the country, finding in the elevated blocks of argillaceous alluvium left isolated by the torrential rains of part of the year a soft but compact and resisting material, have carved in them whole villages of cave-houses, with doors and windows, and often with one story above another. These abrupt elevations, though of moderate height, are extremely numerous, entirely without vegetation, and of an ashy hue. The cave villages are numerous, and, as in the case of Purullana, contain sometimes several hundred inhabitants. One may imagine the devastation among these gnomes which an earthquake shock must produce, and which would go far to explain the great loss of life in these small places.

The shocks felt have been chiefly to the westward of the Sierra Nevada, and have been most severe along the junction of the tertiary rocks with the schists. Here towns have been almost or quite destroyed, and the ruin wrought has been largely proportional to the proximity of the town or village to the unconformability of the rocks, though the motion has been propagated over a much wider area.

THE WORK OF THE SWISS EARTHQUAKE COMMISSION.

THE Swiss earthquake commission was appointed by the Swiss society of natural sciences, in 1879, to secure more uniform and accurate observation and study of the seismic disturbances in and around the Alps. It included such men as Forel, Forster, Hagenbach-Bischof, Heim, Soret, and others of mark as physical-geographers and geologists; and they at once began an active campaign. Professor Heim of Zurich wrote several general articles [1] to call attention to the undertaking, and to outline the method by which intelligent persons could give effective assistance; and since then, he and Forel, both admirably qualified, have prepared a number of monographic reports on the results thus far reached. The official journal of publication is the *Jahrbuch des tellurisches observatorium* of Bern; but, so far as I can learn, none of our libraries possess a copy of it. Fortunately, the reports have mostly been reprinted in periodicals of more general circulation, and from these the notes here presented are derived.

Forel's entertaining papers [2] give the results of the

[1] Ueber die untersuchungen der erdbeben und die bisherige resultate. *Zurich vierteljahresschr.*, 1879.

Die erdbeben und deren beobachtung. Zurich, 1880. This appeared also in French, translated by Forel, in the *Arch. des sciences*, iii. 1880, 261.

Die schweizerischen erdbeben von November 1879 bis ende 1880. *Jahrb. tellur. observ.*, 1881; with an appendix giving important corrections.

[2] Les tremblements de terre étudiés par la commission sismologique suisse de novembre 1879 à fin de 1880. *Arch. des sciences*, vi. 1881, 461.

Id. . . . pendant l'année 1881. *Arch. des sc.*, xi. 1884, 147.

Les tremblements de terre orogéniques étudiés en Suisse. *L'Astronomie*, ii. 1883, 449; iii. 1884, 13.

commission's work in attractive form. It is sometimes even a little amusing to notice the purely scientific treatment that these distressing calamities receive; for, just as an old surgeon will describe a terrible operation as a 'beautiful case,' so Forel writes of a violent shock as 'ce beau tremblement de terre.' Spain must advance far beyond its present superstitions before it can have so calm and judicial a commissioner. The classification that was early adopted is an important matter, and, in the present stage of the study in this country, deserves quotation in full; for, in any statistical comparisons, it is important that the facts on which they rest should be recorded on similar scales. The first principle is the grouping of the fainter antecedent and subsequent tremors with the more violent shocks, as making parts of a single disturbance; and, although this is generally well advised, it sometimes leads to including shocks (*secousses, stossen*) that occurred during ten or more days as parts of a single earthquake (*tremblement, beben*). Thus, in 1880, there were sixty-two tremors or shocks in twenty-one earthquakes; and in 1881 the numbers were one hundred and sixty-three, and thirty-seven for Switzerland alone. The intensity of shocks is measured on the Rossi-Forel scale, as follows: —

1. Very faint; recorded by a single seismometer; noticed only by practised observers.
2. Registered on several seismometers of different construction; noticed by a few persons at rest.
3. Duration or direction noted; felt by a number of persons at rest.
4. Felt by persons while moving; shaking of movable objects, doors, windows; cracking of ceilings.
5. Felt by every one; furniture shaken, and some bells rung.
6. Sleepers awakened; general bell-ringing, clocks stopped, visible swaying of trees; some persons run out of buildings.
7. Overturning of loose objects; plaster falling, general fright; buildings not seriously injured.
8. Chimneys falling; walls cracked.
9. Partial or total destruction of buildings.
10. Great disasters; overturning rocks, forming fissures and mountain-slides.

In order to obtain a measure of the 'value' of the earthquake in which all its elements are included, the area affected and the number of accessory shocks must also be considered. For Switzerland, the areas are grouped by diameters of five, fifty, one hundred and fifty, and five hundred kilometres; and the weak, medium, and strong accessory tremors are counted separately (n, n', n''). Then the total value of a disturbance is $V =$ (Intensity scale $\times$ area scale) $+ n + 2n' + 3n''$. This is evidently a useful method of combining and giving weight to the various peculiarities of an earthquake, but it has a manifest inaccuracy coming from the inequality of the divisions in the scale of intensity. Great earthquakes would not be given their deserved superiority over small ones in such a measurement. It would be improved by squaring the intensity number of the principal shock.

The numerical results thus far announced may be briefly summarized: they give a moderate winter maximum, thus agreeing with Volger's studies of some years ago; a strongly marked preference for the night hours, with a maximum between two and four in the morning, while the minimum is from noon to two o'clock in the day; no sufficient connection is made out between the attitude of the moon and the occurrence of shocks; and the south-western corner of the country has had twice as many earthquakes as any other, but no general map showing distribution has yet been published.

There seems to be no dissent from the opinion that these shocks are in no way of volcanic origin: they are by all regarded as evidence of continued structural disturbance and growth of the Alps. There is no appearance of volcanic action, but evidence of lateral crowding is afforded by every valley that exposes sections of distorted rocks on its sides. The distortion may be slow and uniform, and evenly distributed through the rocks, especially when far below the surface, under the heavy weight of overlying strata; and then it is probable that no disturbance would be felt above. But it may also be irregular by fits and starts, as the crushing stress accumulates to the limit of the rocks' strength, which snap asunder as the limit is passed; and the tremor thus produced is known on the surface as an earthquake. The migration of shocks gives valuable confirmation of this view. Some earthquakes, composed of a number of accessory shocks having a common centre, are properly referred to a single origin: examples of such are found in 1879, vii., and 1880, i., ix., xiii., and xx., of Forel's lists. But in a few other cases the successive shocks must be referred to different centres, which travel or 'migrate' along a line that is naturally supposed to mark a yielding fissure. 1879, v., and 1880, viii., belong to this interesting class. Still more peculiar is the interpretation given by Heim to number xlvii. of his list (June 28, 1880). The observations of this earthquake showed only a moderate velocity of propagation (112 to 204 metres a second) in the direction of the longer diameter of the region affected, and this is regarded as too small for the advance of an elastic earth-wave. Moreover, the local directions of the shock, agreeing fairly well among themselves on either side of the longer diameter, did not agree with the direction of the extension of the disturbed area in time. It was therefore supposed that the disturbance resulted from the successive breaking or slipping of a long fissure, from which earth-waves spread out laterally with normal velocity; thus showing the migration of the focus quickly accomplished in a simple earthquake, much as it had been implied by the more deliberate shifting of the successive shocks in complex disturbances. The explanation is a tempting one, and, if confirmed by similar results in the future, will be an important contribution to seismology.

The statistical results that will, after a few decades, be gathered from these uniformly recorded observations, will be of especial value; and the further development of the connection that has been surmised

between the disturbed areas and the structural features of the Alps will be looked for with interest.

W. M. Davis.

THE CAUSES OF EARTHQUAKES.[1]

I have followed with much interest the details upon the recent earthquakes, which the newspapers have published; but this question is so intricate, so difficult, that I assure you I should not have undertaken its investigation had I thought any other person would have been willing to do so. Meanwhile, at the academy, the question is growing in importance, geologists, geodesists, and others having taken it up with considerable enthusiasm. Under these conditions, I have thought that I ought not to draw back. Nevertheless, I am not without a certain apprehension. Indeed, the question of earthquakes is one of the vaguest. Data are hitherto wanting, but there is no lack of theories; for as in medicine, when there are many remedies for one disease, it is frequently the case that neither is really good, so in geology, in terrestrial physics, when many theories are put forward to explain a phenomenon, it is necessary to cast aside each, and say that none is absolutely sufficient. I start, then, with a certain hesitation; and yet, when one accepts an appointment to study facts of this sort, it seems to me necessary to have in mind some theory, true or false, and to adopt it more or less boldly, free to abandon it after contradiction.

I start, then, with a certain idea which I expect to verify or invalidate. I do not propose to tell you what it is: I will simply ask your permission, before giving my plan of studies, to point out in a few words the current theories to account for earthquakes.

There are four principal ones. They are very old. We find them in the Greek authors, and perhaps, if one were to search carefully, they would be found among East-Indian traditions. The first is based upon the supposition, that, under the solid crust of the earth, the sudden generation of gases and vapors causes subterranean explosions; and it is the effect of these shocks that we feel on the surface. This would be in a way comparable to an explosion of dynamite taking place at a great depth. I need not discuss these theories, yet I may say that perhaps this one is true when applied to earthquakes in the neighborhood of volcanoes. It is certain, indeed, that as soon as the earth opens, great quantities of gas are liberated from beneath the surface, where in some way they have been generated and furnished with extraordinary power.

But even if this theory is probable with regard to volcanic earthquakes, I think that it would be difficult to apply it to those in Spain.

A second theory has been proposed by a learned physicist, Alexis Perrey. It is based upon the supposition that the combined influence of the sun and moon, acting upon the liquid parts beneath the surface, produces tides analogous to those on the surface of the earth. These vast tides of liquid fire at certain favorable movements, striking upon the solid external crust, cause the earthquake shocks. I also abandon this theory, for I do not think it can apply to Spain.

There remain two others, one that of Scheuchzer, a distinguished *savant*, at once paleontologist, geologist, and physicist. Having studied the earthquakes in Switzerland, he has attributed them, not without reason, in certain particular cases, to the falling-in of subterranean caverns caused by the dissolving-out of such substances as salt or gypsum by water which has penetrated beneath the surface. Such a collapse would, without doubt, cause a very appreciable shock at the surface of the earth. This theory may apply to certain special cases; but it remains to be seen if it applies to the Spanish earthquakes.

There is a fourth which is at present in favor in Germany among nearly all geologists of that country, and it has also been accepted by some in other countries. In France it has not been so well received: nevertheless, there are eminent men who entertain it. It is based upon geological observations. There are no geologists, indeed, who, observing the walls of the cracks in the metamorphic rocks, for instance, have not been struck by the fact that these beds, originally deposited in a horizontal position, have been raised and broken. There have evidently been movements of extreme importance, since rocks that were originally connected and regular are now in the greatest disorder. Now, it is certain that these movements could not have been produced without superficial shocks at the moment when the fissures were made. Therefore there must have been earthquakes in all geological epochs, even the most ancient, which are exactly comparable with those of to-day. But reciprocally, if these ancient foldings have produced earthquakes, why are not the present earthquakes the result of analogous phenomena?

You see that the theory is perfectly regular up to this point. It is only necessary to know (the difficulty is merely thrown back in time) what is the origin of these foldings, of these fractures. Why these out-throws, these subsidences, these convolutions? We then arrive at a very old explanation, given by geologists, and still admitted by many *savants*. It is that the earth is continually cooling, and so contracting. The superficial crust has reached a nearly constant temperature; but this is not true of the liquid portions adjacent to it, where the temperature must be very high, though constantly cooling. In cooling, its volume becomes less, and its contractions cause foldings and fractures in the solid crust. This theory is rather old, it is true, but there is no better theory at present.

As to the Spanish earthquakes, it seems to me, that, of these four theories, only two should receive any attention.

The question is, therefore, whether there are fissures, bendings, and faults beneath the surface, or whether the water is dissolving out caverns. In a

[1] A communication to the French geographical society, on Jan. 23, by Mr. Fouqué, professor of geology in the Collége de France, and chief of the commission appointed by the Academy of sciences to study the Spanish earthquakes.

word, the subject for research is whether one of the last two theories will apply to the case in question. You will notice, moreover, that each of these theories presumes a geological cause. It is in part, I think, this idea of the connection between earthquakes and the movements far below the surface, that has influenced the Academy of sciences in choosing a geologist to examine the phenomenon.

In my turn, — and for the same reason as the Academy of sciences, — I have taken geologists as collaborators. Those who accompany me are Messrs. Michel Lévy and Marcel Bertrand, members of the geological survey of France, and mining engineers of great competence. The third who accompanies me is Professor Barrois, of the Faculty of science at Lille, an eminent geologist, who is well acquainted with the Spanish soil.

I have, then, as my associates, three geologists, perfectly competent to study all the facts that are usually investigated in earthquakes, — the propagation of the motion, the direction of the shock, and the place of greatest intensity. They are also capable of determining the relations which exist between the superficial action of an earthquake and that which may be going on at great depths. Geologists, when they travel over the surface of a piece of ground, see not only the superficial beds, but, by a sort of instinct, they divine the character of the deeper extensions. Sometimes they are mistaken, — they are not infallible, — but still, in the most cases, they are able to determine the constitution of the deep strata. This, then, is one special point which we shall endeavor to determine.

We wish, from the study of the superficial deposits, to deduce its geological structure at a certain depth. On the other hand, with the means which we possess to-day, it is possible to determine approximately the depth from which an earthquake shock originates. We have two methods for this. One, which is founded upon very precise and delicate observations, has been proposed by Mr. Seebach: it is based upon the determination of a series of points, in which the oscillations are felt at the same moment. These observations are extremely difficult to obtain.

There is another, older method, due to the English physicist, Mallet. The system of observations proposed by him is based upon the examination of the cracks in the land after an earthquake. These fractures are, in nearly every case, normal to the direction of the shock; and, when one studies them carefully, the direction of these normals is sufficient to fix their points of convergence, and hence the origin of the shock.

The methods of which I have spoken are not purely theoretical: they have been applied five or six times by Germans, Italians, and English; but, unfortunately, the French have not yet used them. They have given very interesting results; as, for instance, in the last earthquake at Ischia, it has been shown that the cause of the concussions came from a depth of from twelve hundred to eighteen hundred metres at the most. Between twelve hundred and eighteen hundred metres there is certainly a considerable range; but one would have expected to find that the shock came from a much greater depth. Consequently much is already accomplished, when we can limit the origin of the phenomenon to a space so restricted.

I said that we were able to apply these two methods, the one certainly, the other probably. We may thus ascertain the depth of the earthquake's centre. If, on the other hand, we are able to determine by geological observations the constitution of the earth at this point, we shall have obtained a datum extremely important, and we may be able to accept one of the two theories, or so to limit one or the other as to make it agree better with the facts.

These are the objects of our mission, these the things we count on accomplishing. You will see that it is very simple. I hope that we shall obtain satisfactory results. I do not dare to promise that we shall; but I do promise you that we shall study Andalusia, or a portion of this province, with care, and that we shall bring back data of geological interest and importance from this very curious country.

SEISMOLOGICAL NOTES.

The earthquakes of the last year in England have, like those in this country, aroused an interest in seismometry; and the committee of the Scottish meteorological society, who have charge of the Ben Nevis observatory, have asked Professor Ewing (whose work in Japan we recently noticed [vol. iv. p. 516], and who is now professor of engineering in University college, Dundee) to institute earthquake observations on the top of Ben Nevis. Professor Ewing has received a grant of a hundred pounds from the committee controlling the government grant for scientific investigation, and will proceed to set up apparatus to detect, and probably to record, minute earth-tremors, and also slow changes of level of the ground.

In connection with the recent Spanish earthquakes, it is interesting to note that we have accidentally brought into prominence a new kind of seismoscope. In *Nature*, vol. xxxi. p. 262, Mr. Ellis of the Royal observatory at Greenwich states that the continuous photographic records of the declination and horizontal force magnetometers both show a simultaneous disturbance, different from the ordinary magnetic disturbances, occurring on the evening of Dec. 25, a few minutes after the reported time of the severe earthquake in Spain on that date. No ordinary magnetic disturbances were recorded on this and neighboring dates, and the earth-current registers showed no change; so that there would seem to be little if any reason to doubt that the unusual disturbances recorded were caused by the swinging of the magnets on their suspending fibres, due to the shaking of the points of suspension by the Spanish earthquake. If some method were devised of photographing the lateral swing of the magnets in two azimuths at right angles, in addition to the present torsional swing as magnetometers, these instruments could, perhaps, be made very sensitive seismoscopes as well, and the accuracy of the time-record would only depend upon

the velocity given to the strip of photographic paper. Of course, as *seismometers,* they would be as worthless as all stable pendulums must be; but as *seismoscopes,* they might be quite sensitive, and the expense and requisite attention need not add greatly to that already necessary with the magnetometer.

In Japan, Professor Milne keeps up his active work in seismology. During the last summer, he spent five days on the top of Fujiyama, attempting to detect diurnal changes in the level of the ground. The results have not yet been published. This mountain — a wonderfully symmetrical volcanic cone, about twelve thousand feet high, and the most striking object in all Japan — is the one on whose summit Professor Mendenhall made a determination of the force of gravity and of the values of the magnetic elements; and it will always be an interesting point for scientific observations of all kinds, rising as it does in complete isolation out of a plain.

In vol. vii. part 2, of the *Transactions* of the seismological society of Japan, Professor Milne contributes a paper upon three hundred and eighty-seven earthquakes observed in northern Japan between October, 1881, and October, 1883. A map is given for every quake, showing by its colored portion the approximate area covered by the shock, as determined by Professor Milne's system of tracking down earthquakes by a system of postcards distributed to all important places in the hands of observers who send in weekly reports of the occurrence or non-occurrence of any disturbances. In this way Professor Milne has had the northern part of Nippon and the southern part of Yezo covered for several years with a network of forty-five observers, besides those in Tokio and Yokohama. At five of these stations quite accurate time-observations of the disturbances were frequently obtained by the help of good clocks compared several times per week with the daily telegraphic noon signal from Tokio. A catalogue of the individual observations of each of the three hundred and eighty-seven shocks is also given. Some of the results are worth noting. As regards geographical distribution, it is remarkable that only two out of the three hundred and eighty-seven shocks appear to have extended to the west of the range of mountains running up the western side of the island of Nippon, being apparently stopped by that barrier, while about eighty-four per cent seem to have originated either out under the ocean or very near it on the eastern side of the islands. Commenting on this, Professor Milne says, —

"The district which is most shaken is the flat alluvial plain of Musashi following the line of the river Tonegawa. . . . This area forms one of the flattest parts of Japan. The large number of earthquakes which have been felt on the low ground, and the comparatively small number which have been felt in the mountains, is certainly remarkable.

"It must also be observed, that, in the immediate vicinity of active or extremely recent volcanoes, the seismic activity has been small. . . . It may also be remarked that the side of Japan on which earthquakes are the most frequent is the side which slopes down steeply beneath an ocean which at a hundred and twenty miles from the coast has a depth of about two thousand fathoms, whilst on the opposite side of the country, at the same distance from the shore, the depth is only about a hundred and forty fathoms. Another point not to be overlooked is the fact that the district where earthquakes are the most numerous is one where there is abundant evidence of a recent and rapid elevation.

"In all these respects the seismic regions of Japan hold a close relationship to similar regions in South America, where we have earthquakes originating beneath a deep ocean at the foot of a steep slope on the upper parts of which there are numerous volcanic vents, whilst, on the side of this ridge opposite the ocean, earthquakes are rare. With regard to the Musashi area, it may also be remarked that sediments brought down by numerous rivers from the higher parts of the country are accumulating on it at a very rapid rate."

The distribution of the three hundred and eighty-seven earthquakes for the four quarters of the years was as follows, — January - March, 195; April - June, 70; July - September, 39; October - December, 83, — thus confirming the greatest activity in the coldest, and least in the hottest, months of the year, which had been shown before for the Tokio district alone for a long period of years.

With respect to the measurement of the motion of the ground, most of the facts deduced by Professor Milne are substantially the same as those summarized by Professor Ewing in his memoir referred to above. The following, however, which is partly, at least, new, deserves quotation here: —

"Inasmuch as it will be observed that different instruments give different results for the same earthquake, in order that the reader may not regard such diagrams as conflicting, the following results, which have been obtained from the earthquakes here referred to, and which have been confirmed by many observations made subsequently, may be enumerated:

"1. An ordinary earthquake, although having a general direction of propagation, has at a given point many directions of vibration. If there is a decided shock in a disturbance, this particular movement may be indicated in the same manner at adjacent stations.

"2. The amplitude of motion as observed at two adjacent stations, even if only a few hundred feet apart, may be extremely different.

"3. The period of motion may vary like the amplitude, the instruments being in all cases as similar as it is possible to construct them.

"At present I am carrying on observations by means of three similar instruments placed at the corners of a triangle the sides of which are about eight hundred feet in length. When these instruments are side by side, they practically give *similar* diagrams. At their present positions, they always give *different* diagrams. If these instruments were in the hands of distinct observers, each of these observers would give a totally different account of the same earthquake. Judging from the quick period and large amplitude of motion always observed at one particular corner of my triangle, I can say with confidence that at this corner there might be sufficient motion to shatter a building, whilst at the other corners similar buildings would not be damaged."

He does not state whether there is any difference in elevation or in character of soil at the corners of this triangle; but, if there is none, then this observed difference of motion is highly interesting and important, and should be tested and verified in every possible way by interchange of instruments, resetting of supports, etc., in order to be sure in every way that there is no local peculiarity of instrument or method of attachment to the soil. Doubtless this will have been fully attended to in Professor Milne's continuation of these interesting experiments.

H. M. PAUL.

A RECENT DISCUSSION OF THE AXIOMS OF MECHANICS.

THE logic of the physical sciences will always remain a fascinating field for the philosophic inquirer, and doubtless also for the special student of those sciences. The recent efforts towards a 'reform in logic' in Germany have not left this field untouched; and one of the first in importance, among the books that bear on the general topic, is the work whose title is given below. The author has qualified himself for the task by a lengthy study of the history of the development of his science, and he has the power to suggest much more than he directly says. In short, we have here a man who combines definiteness with depth of thought; and his book, whether useful or not to the specialists in mechanics, is surely very suggestive to the student of logic.

The author represents in his way the new empiricism of Germany, — a doctrine that has grown up out of a study of Kant and the English philosophy combined, and that as certainly points back again into the realm of specially philosophic discussion as it appears anxious to be forever beyond that realm. This new empiricism is much more suggestive than the older empiricism of J. S. Mill. He had founded all inductive interpretation of nature on the causal principle, and the causal principle itself again on an inductive interpretation of nature. The new empiricism escapes from this circle by assuming a relatively *a priori* principle in all induction, but seeks to remain empiricism still by making this principle no abstract axiom, but a sort of ultimate form or tendency of intelligence, viz., the tendency *to conceive of the facts of experience in the most economical way.* This interest in economy of thought shall, in the new empiricism, take the place of the old axiom of causality, and, in fact, of all the mysterious axioms of past logicians. This tendency to economy is to be the true *a priori* that Kant sought. It is to give us no knowledge transcending experience, but only a necessary presupposition concerning experience. What for bare experience would seem a confused mass, becomes for the scientific thinker, by virtue of this tendency to economy, a world of law. All the laws are indeed statements of empirical fact; but the statements never could assume this form save by virtue of the effort to economize thought.

Such is the general statement of the new empiricism. Our author, for the most part, confines his use of it to his special task, and lets general philosophy as much as possible alone. Yet he cannot but constantly suggest to the reader the philosophic problems peculiar to his method. For the rest, he lays claim in the preface to considerable relative originality in the development of his own doctrine. Before Kirchhoff and Helmholtz applied to mechanical science the general theories of the new empiricism, Mach had outlined his views in a published essay. He is thus entitled to individual credit, and open to separate criticism.

Applied to mechanical science, the new empiricism, as our author and Kirchhoff have expressed it, takes the form of declaring the purpose of mechanics to be, "the simplest possible description of the motions that are in the world." Thus at a stroke the science is to be freed from all mysterious elements. Those old ideas of force, of inertia, and the rest, are to be defined afresh in such a way as to conform to this logical theory. The science is to have its two perfectly plain bases; viz., experience of motion, of velocity, of direction, etc., and the effort to think this experience with the least effort and the greatest unity.

The historical form that Mach gives to his doctrine makes it especially attractive and enlightening; and we hope for much good effect from this element in the book. Mechanical science, as Mach frequently repeats, had its origin very plainly in the need of men whose handiwork, owing to its technical complexity, was difficult to describe to those new in the craft. The learner must be enabled to see the permanent elements of the experience of his craft beneath, and in all their endlessly various applications; he must be brought to an 'übersichtliche erfassung der thatsachen:' hence the need of quite general and simple descriptions, applying to fundamentally important facts. Economy of description thus from the first becomes the artistic principle, as it were, of this technical instruction.

If this is the origin and general method of the science in its embryonic stage, the origin

Die mechanik in ihrer entwickelung historisch-kritisch dargestellt. Von E. MACH, professor an der Universität zu Prag. Leipzig, *Brockhaus*, 1883. 10+483 p., illustr. 8°.

of the use of axioms appears, according to our author, in the fact that the learner, from long habit (not, as Mach thinks, from any *a priori* insight), has come to expect instinctively, and so to conceive very economically, certain simple sequences of facts. Purely for economic reasons, and not on philosophic grounds, nor for that matter with any philosophic justification, the teacher is disposed to seize upon these elementary facts as the constituents into which more complex facts can be analyzed, and by which these cases can be easily described. These simpler sequences are chosen simply because the learner already knows of them, and can more readily grasp them. When one calls them *a priori*, one forgets how easily a puzzling question can confuse us about their meaning, and even about their truth. Their self-evidence is the self-evidence of instinct, and they are in no philosophical sense *a priori*.

After the foregoing summary, we may fairly assert that in one respect, at any rate, Mach's method is praiseworthy; and that is, in its tendency to get rid of the mysterious element of his science. Whatever one may hold about the *a priori* in general, there is no doubt that we have had enough and too much of the purely mystical *a priori*. If there is any fundamental rational truth at the bottom of science, if science is more than a mere aggregation of facts, this rational basis, when we come to state it, must be as frank and honest and manly a principle as the most commonplace adherent of the empirical philosophy could desire. The old-fashioned *a priori*, in science, in morals, in religion, used to be represented as an arrogant and intolerant thing, mysterious in its manner of speech, violent and dogmatic in its defence of its own claims. The English empiricists used to hate this aristocratic *a priori*, and they shrewdly suspected it to be a humbug. What they gave us in its place, however, was a vague and unphilosophic doctrine of science, that you could only seem to understand, so long as you did not examine into its meaning.

Mach's view avoids the mystery of the old *a priori*. He leaves us still the mystery of the correspondence of external nature to our fundamental interests in the simplicity of its phenomena. Yet this mystery has the look of the genuine philosophic problem. The new empiricism is not and can not be final; but it promises to prove an excellent beginning, and one can at least commend it to those instructors in elementary mechanics who still puzzle their pupils with their use of the old-fashioned, mystical *a priori*. Mach's fundamental principle of the economy of thought is one that any intelligent pupil, with a few empirical facts before him, could be got to understand. But, as many not extraordinarily stupid pupils have so often felt, the mysterious way in which such axioms as the 'principle of sufficient reason' used to appear, aimlessly wandering to and fro in the text-books, could not but perplex, without in any wise helping, the young mind. That even to-day, when the empirical methods in elementary mechanics are so well developed and so generally used, the 'principle of sufficient reason' is occasionally called in to help teachers and text-books out of difficult places, — this fact is surely a 'sufficient reason' in itself for a careful study of such books as Mach's. There are many teachers of elementary mechanics to-day, who, while abhorring metaphysics, and constantly glorifying experience, never know or can tell just what ought to be done with that 'principle of sufficient reason,' which, however, as it used to be applied when it held sway in elementary mechanics, was the most miserably 'metaphysical' of all confused statements. The most ardent believer in the rational *a priori* must therefore delight to find, in such a book as Mach's, the foundation laid for future philosophic inquiry in the clear and sensible empiricism of the author, tentative and transient though this doctrine itself may prove. Only when the vague and mystical have been banished from the mere terms and axioms of the science, can a philosophic student hope successfully to grapple with the question, "How is empirical science, with certain and fixed results, possible at all?" Every one is therefore interested in such undertakings as our author's, whether one is student of mechanics or of logic, or teacher of either; for every one is interested in plain and frank thinking, free from appeals to merely mystical principles.

In concluding, we must call special attention to our author's discussion of the question of absolute and relative motion, which he seems to us to have treated with marvellous skill; and thus we are obliged unwillingly to leave a book that is so full of learning and suggestion.

THE SNAKE-DANCE OF THE MOQUIS.

Capt. Bourke has given us here a most interesting account of his experience among the

The snake-dance of the Moquis of Arizona; being a narrative of a journey from Sante Fé, New Mexico, to the villages of the Moqui Indians of Arizona, with a description of the manners and customs of this peculiar people, and especially of the revolting religious rite, the snake-dance. By John G. Bourke, captain third U.S. cavalry. New York, *Charles Scribner's sons,* 1884. 371 p., 31 pl. 8°.

Moqui Indians. It is a fascinating book, both to the scientific and general reader. With a graphic pen he carries you with him on a long trip replete with thrilling incidents, over regions seldom visited. The book savors rather of a conglomeration of detached notes, than a compilation. Perhaps too much was attempted in trying to give a popular account of his trip, and yet preserve the flavor of the note-book written on the spot, which is so valuable for scientific purposes. He seems also to have fallen into the mistake of supposing his readers to be cut off from books, as he unfortunately was, and has filled the larger part of three chapters (pp. 196–225) with quotations which it would have been sufficient to give by reference. The minuteness of detail with which he describes every circumstance seems unnecessary while his travels were in not unknown regions; but they become invaluable when he describes the snake-dance, and his visits to the various Moqui villages. The book consists of an account of a dance in one of the pueblos on the Rio Grande, which is curious from its mixture of old heathen ceremonies with the Roman forms introduced by the Spanish priests; then of his trip through a corner of the Navajo reservation to the Moqui village of Hualpi (pronounced Wolpi), where the snake-dance was witnessed; and then of visits to the other pueblos of the Moquis. These Moquis occupy several isolated *mesas* in north-eastern Arizona, and are by far the most primitive of all the Pueblo tribes. They were not affected even by the Spanish civilization, as were all the other tribes, including the closely related Zuñis, and are to-day almost what they were four hundred or more years ago. Their life, habits, costumes, and industries are described with an accuracy and minuteness which renders the book invaluable to the ethnologist, and yet so entertainingly that no one can fail to be interested. The snake-dance seems to be the last remnant of what was once an almost universal worship among the tribes of North America. Owing to fortunate circumstances and his own coolness and untiring perseverance, Capt. Bourke was able to see even the secret ceremonies of this dance, which no white man has seen before, or will be likely to see so thoroughly again.

The plates accompanying the work are admirable reproductions of the artist's paintings. It is sufficient to say that the paintings are by Moran, and are accurate in color and drawing, as well as spirited and realistic, — a quality generally absent in illustrations of Indians. They alone are worth the cost of the book.

NOTES AND NEWS.

THE meteorological observatory at Tokio has recorded 546 Japanese earthquakes in the ten years ending Dec. 10, 1884. Of these, 334 (or fifty-six per cent) have occurred during the six colder months, and 212 (or thirty-five per cent) during the six warmer months, of the year. Professor Milne's compilation of 387 earthquakes observed in northern Japan in the two years ending October, 1883, however, shows a still greater proportion for the winter months; the percentages being seventy-two for the months from October to March inclusive, and twenty-eight from April to September.

— Prof. J. P. O'Reilly has recently published in the Transactions of the Royal Irish academy a map of Great Britain and Ireland in which he has attempted to graphically represent the earthquakes of the United Kingdom relative to their frequency. It would appear that Ireland has been less subject to shocks than Great Britain; that the points of more frequent action in Ireland lie near or on the coast; and that the south coast of England presents a number of points of activity situated approximately on the same line, in all probability connected with a system of jointing corresponding to the general direction of the coast.

— Dr. M. Eschenhagen writes to *Nature* that the earthquake shock of Dec. 25 last was registered by the magnetograph at the imperial marine observatory at Wilhelmshaven; the Lloyd's magnetic balance, the instrument for vertical intensity, being set in oscillation first at 9.52 P.M., local time.

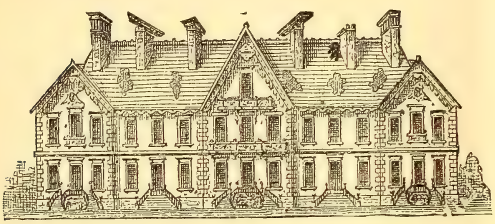
— The earthquake wave of Jan. 22 last in England appeared to the vicar of Bampton to pass directly under his house. A letter from Mr. Edward Parfitt in *Nature* states that it occurred at 8.42 P.M. In the drawing-room at the vicarage it appeared as if a heavy traction-engine was passing close to the window: the window faces eastward. In the kitchen the servants were greatly alarmed by a rumbling noise and a shaking under the floor. Some of the vicar's neighbors say they heard a report; and houses with cellars under them, and higher, felt the shaking more. Some persons who were up stairs, thinking that it was some explosion, rushed down stairs and out of doors. The effects were also felt at Shillingford, two miles distant; and also at Combehead, one and a half miles distant. The porters at the station describe it as like a heavily-laden mineral-train passing. The only damage done at Bampton was that a piece of wall was thrown down.

— It is suggested by the Seismological society of Japan that the system of telegraph-stations around Tokio and Yokohama may be utilized in warning the inhabitants of either city of the approach of an earthquake. This might be accomplished by causing such a shock, felt at any of these stations, to complete an electric circuit which could be made to fire a gun almost instantaneously. The inhabitants would receive from two to six minutes' warning, which would give them sufficient time to extinguish their fires,

remove their most valuable goods, and reach open ground before the arrival of the shock.

— A recent issue of *La Nature* (Jan. 3, 1885), describing an earthquake which occurred in the valley of the Durance in south-eastern France at eleven P.M. on Nov. 27, 1884, notices and illustrates this curious phenomenon.

"The roof of a chalet at Sainte Catherine was suddenly transformed into a vibrating plate, and was broken in several equi-distant places. These injuries could not be attributed to the fall of bricks from the chimneys. The slates were dislodged, and not broken; and the exposed portions of the wood-work, far from being in the vertical line from the chimneys, were found at precisely equal distances from each other. Moreover, the outside chimneys have not lost a single brick, and yet the roof is as much injured in these two places as in the others."



CHALET AT ST. CATHERINE, SHOWING ROOF BROKEN BY EARTHQUAKE.

The chalet referred to is represented in the accompanying illustration as a brick building with sloping roof, divided by a central projecting gable, and surmounted by a row of six chimneys, each capped with a large flat stone. The end chimneys are uninjured; but the capstones of the four middle chimneys have been more or less moved from their places, and one has disappeared entirely, making a hole in the roof by its fall. Besides this hole, which is at the upper side, and close to the chimney from which the stone fell, there are upon the lower part of the roof five spots where the slates are removed, as if these had been the ventral segments of a stationary vibration set up in the roof; its normal period of vibration, when thus divided, happening to agree with the period of some of the vibrations caused by the earthquake.

— *Nature* states that fresh shocks of earthquake occurred on Jan. 27 and 28 in the hot-spring district of southern Styria. A severe and prolonged shock was felt at Valparaiso at four o'clock on the morning of the 27th; and on the 31st a shock destroyed eight Arab houses in Algiers: this last was also felt at Setif.

— The Rev. Mr. Doane writes from Ponape, Caroline Islands, in October, 1884, of the arrival, in large quantities, of pumice-drift ejected by Krakatoa a year before. It is a boon to the natives, who crush the pumice, and fertilize the arid coral sand of the low atolls with it.

— The telephone is to be introduced into the Kongo region by the International African association.

— Capt. Scopinich, of the Austrian brig Mater, reports having experienced terrific earthquake shocks on the 22d of December, 1884, in the vicinity of the Azores. The weather was very fine at the time, with a light easterly breeze.

— The committee on thought-transference, of the American society for psychical research, has issued a circular requesting the co-operation of all persons interested in investigating the subject; that is, in ascertaining whether "a vivid impression or a distinct idea in one mind can be communicated to another mind without the intervening help of the recognized organs of sensation." It is the intention of the committee to make experiments upon persons supposed to have the faculty of 'mind-reading.' The committee also desires to collect statistics as to experiments of uniform character, but made by a large number of observers, similar to those made by Charles Richet, and described in *Science* (vol. v. p. 132). Precise directions for making each series of experiments are appended to this circular. In entering on this inquiry, the committee wish to be understood as expressing no opinion, on one side or the other, in regard to the reality of the supposed thought-transference. They simply seek to institute a thorough and entirely unbiassed investigation of the class of phenomena known under the name of 'mind-reading,' in the hope of taking at least a distinct step towards the true explanation of those phenomena, whatever that explanation may be. All inquiries and communications should be addressed to the secretary, Mr. N. D. C. Hodges, 19 Brattle Street, Cambridge, Mass.

— In their report on underground circuits, the committee of examiners of the Philadelphia electrical exhibition call attention to the desirability, in the present tentative condition of our knowledge of underground wires, of all conduits built for such purpose being so constructed as to be easily adaptable to a number of systems. In regard to conducting electric currents underground, the committee records its opinion that there can be no doubt of the ultimate feasibility of the scheme.

— The first number of *Petermann's mittheilungen* for this year appears under the editorship of Dr. A. Supan, well known for his writings on matters of physical geography. The articles are chiefly concerned with explorations and general descriptions; but continued attention is promised to physical geography as well, and the current bibliography that closes the number includes mention and abstract of several papers of this character. Most of these abstracts are by Dr. Supan himself, while the monthly review of exploration is by Dr. Wichmann.

— The foundation of a chair of hygiene at the University of Berlin is an accomplished fact. Besides the professorship, a laboratory for hygienic research is to be instituted.

— The Italian explorer, Signor Franzoi, intends to undertake another six or seven years' expedition into central Africa.

Specimen of Engraving and Printing, by STRUTHERS, SERVOSS & Co., 32 & 34 Frankfort St., New York. Printed from Relief-plates—six impressions.

The Red line from Jerusalem North marks the route followed in the present journey. The line from Gaza shows the approach from the South in coming up from the Desert.

[From "Among the Holy Hills," by the Rev. H. M. Fields, D.D. By permission Messrs. Chas. Scribner's Sons, New York, Publishers.]

SCIENCE.

FRIDAY, MARCH 13, 1885.

COMMENT AND CRITICISM.

A PLAN is on foot for establishing in Mount Royal park, Montreal, a botanic garden, to be under the joint care and patronage of McGill university and the Horticultural society. Those who are familiar with the superb park and its deservedly famous drives will at once understand what an unrivalled opportunity Montreal possesses for giving to its citizens another source of enjoyment. With a water-supply practically limitless, and with every needful exposure to the sun upon its slopes, the mountain furnishes as fine a location for a botanic garden at the north as can be imagined. It is wisely suggested that much prominence be given, in the new enterprise, to the special horticultural and arboricultural features which offer so wide a field for profitable study in our northern climates.

Of the educational advantages to university students, of a botanic garden and an arboretum, it is superfluous to speak, since they are self-evident; but it may be well to refer briefly to the great value to a community of a botanic garden as a means of culture to the children in the public schools, as well as to the thousands who can find little time, and who have but little inclination, to acquaint themselves with the world of beauty around them. In a properly arranged botanic garden, the groups of plants having different and interesting habits — for instance, the climbers, the insectivorous plants, the weather-plants, and those which furnish the principal vegetable products — are visited and carefully examined by many who would otherwise seldom look into the book of nature. We presume that no scientific man can object in any reasonable way to such a method of popularizing science. The enterprise is fortunately to receive the judicious care of Professor Penhallow of McGill university. We wish the plan all success.

WE HAVE given space to Mr. Cox's long letter attacking our comments upon microscopists, because he has brought against us an accusation of unfairness. We can assure Mr. Cox that our expressions were induced by no *animus* or personal feeling, but were called forth by the tendency, specially marked in this country, to give a separate dignity to microscopy, and to glorify the tool at the expense of the work. The microscope is a tool, like the tweezers or the hammer; and the sciences cannot be divided according to the tool used. That microscopes are so fine and elaborate may explain, but does not lessen, the error of regarding microscopy as a separate science. To make microscopy as generally understood, a little petrography is patched together with a little anatomy, some parts of botany, a little crystallography and chemistry, and some optics. Mr. Cox invites a comparison with astronomy as the science of what is beyond vision in distance; but the astronomer is not a telescopist, and does not claim that every thing which can be done with a telescope should be grouped together under one science. He recognizes his instrument as his tool.

The microscope is a noble apparatus; and one who thoroughly studies all the principles involved in its construction, and invents improvements in it or its use, is deservedly to be called both a microscopist and a scientific man. Usually the microscopist is, however, confessedly an amateur, and gives his attention to very various objects; while those who use the microscope constantly — the pathologists, embryologists, botanists, petrographers, etc. — unquestionably prefer to be called after the department of science they follow, not microscopists after their instruments. We think

there has been a tendency to exalt the amateur's microscopy to the rank of a separate department of science, and therefore we plead not guilty to Mr. Cox's accusation of injustice. It is proper for *Science* to point out a confusion as to the natural demarcations of the sciences, or to call attention to the fact that there is a body of men who are much interested in certain parts of science, but yet chose their interests in so many fields, that they lack that rigorous thoroughness which is indispensable for pure science, and which, in its turn, makes specialization indispensable.

WE REGRET to announce the resignation, by Professor Harrison Allen, of the chair of physiology at the University of Pennsylvania. Our regret is increased by the fact that the step is the consequence of the pressure of overwork, and the growing demands of a large medical practice. We hope that his professional activity will not prevent the continuance of the important researches upon which Professor Allen has been engaged. The loss to the university will not be readily made good; for Dr. Allen is not only an investigator of thoroughly scientific spirit, but also one who is singularly appreciative of the good work of others, and encouraging to his co-laborers, as has been shown most happily in the recent establishment of the Biological institute at Philadelphia, in which Dr. Allen had efficient participation. The university will certainly miss his experienced co-operation.

IT IS premature to comment on the plan of examination for admission now under consideration in the faculty of Harvard college. It is known that such a plan has been found, in its general features, to furnish a satisfactory ground of truce between the combatants, and that both the classicists and the modernists in the faculty are well contented to unite in it as affording a wise and fair adjustment of their differences. But the discussion has not yet reached its final stage, and some important questions still remain to be considered. At the proper time we shall lay before our readers a full account of whatever system of requirements is ultimately adopted.

THE PROVISIONS for the scientific bureaus of the government, made in the sundry civil bill passed at the close of the last congress, are, on the whole, less generous than in the preceding year. The appropriations for the weather bureau, including the military branch ($883,433), and for the coast-survey ($551,-498), are slightly greater; those for the geological survey ($467,700) and the ethnological bureau ($40,000) are the same; that for the national museum ($147,500), scarcely less than a year ago; but the fish-commission receives only $256,000, which is $65,000 less than last year; and to the census bureau nothing is given (it received $10,000 last year). Thus the natural necessary growth of some of these institutions is not provided for.

ON THE other hand, the Smithsonian institution is given $10,000 for maintaining its excellent work in foreign exchanges; $10,000 is appropriated for operating the Watertown testing-machine, and $12,000 for printing the continuation of the catalogue of the medical library attached to the surgeon-general's office; while the joint commission of three senators and three representatives, to consider the present organizations of the signal-service, geological survey, coast and geodetic survey, and the hydrographic office, is continued, and instructed to report at the next meeting of congress.

BY THE sundry civil bill, the president is authorized, in case of threatened or actual epidemic of cholera or yellow-fever, to use at his discretion the unexpended balance of the sum re-appropriated for this object in July, 1884, together with the further sum of $300,-000, in aid of state and local boards or otherwise, "in preventing and suppressing the spread of the same, and for maintaining quarantine and maritime inspections at points of danger; and, by the meagre appropriation of $15,000, the national board of health is resuscitated.

This is emphatically a step in the right direction. Under the provisions of the act, much valuable information in regard to either of the diseases mentioned may be obtained; and, if either of them visits the country, it is to be hoped that something of scientific value will be added to our knowledge of the means of fighting it. We should have been glad to see an additional special clause providing for the appointment of experts to investigate at least the first cases which occur, for it is by the rigid inspection of these often doubtful cases, by accurate diagnosis and successful isolation, that an epidemic is to be arrested. Without a special recommendation of this kind, there seems to be too much danger of the omission of rigorous measures at the most important time.

THE RECTIFICATION of public practice in accordance with scientific theory is always gratifying. Attention was recently called to certain results of the mode of educating deaf-mutes by means of silent signs and in seclusive institutions, — threatening no less a calamity than the creation of a deaf-mute variety of mankind, — and to the desirability of training deaf children in the use of common speech, in association with hearing children, and without removal from family influences. The memoir on this subject by Prof. A. Graham Bell, embodied in the Report of the National academy of sciences presented to congress last year, has led to much discussion of the subject. The first fruits are seen in a bill now before the legislature of the state of Wisconsin, which provides for the establishment of small day-schools for the deaf in any incorporated city or village in the state. These schools will be under the control of the state superintendent of public instruction.

This is a movement in the right direction. Existing institutions for the education of the deaf are under the management of the boards of state charities. But this pioneer legislation of Wisconsin recognizes the obligation of the state to provide education for all her children, not as a charity, but as a right. The establishment of these day-schools was recommended by Gov. Rusk in his message to the legislature last January, in which he says, "There were in Wisconsin, according to the census in 1880, 1,079 deaf-mutes, of whom 600 were of school-age, between six and twenty, and less than one-third of these were receiving instruction." An equally large proportion of deaf children are growing up in ignorance in all our states; and the question is forced on public consideration, whether to enlarge and increase the number of state institutions, or to supplement those already existing by the provision of day-classes for the deaf, in connection with our common schools. The Wisconsin experiment will be watched with interest: its results can only be for good; and the example of that state in taking a new departure of this kind is worthy of being generally followed, that the tests may be conclusive for the whole country.

Prof. A. G. Bell was invited by the committees on education, of the senate and assembly of the legislature of Wisconsin, to present his views for their information; and, after completing his *viva voce* explanations, he addressed an open letter to the committees, in which his arguments are recapitulated clearly and compactly. This document we commend to all who are interested in the subject. We have room for only one quotation: "Out of a total of 33,878 deaf-mutes in the United States in 1880, 15,059 were of school-age; and the total number of deaf-mutes returned as then in the institutions and schools of the United States was only 5,393." This fact alone shows the necessity, not only of doing something, but of doing it without delay.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Decadence of science about Boston.

I OBSERVE that this subject is still discussed in a recent number, but that no one ventures to raise a doubt as to the original assertion. Yet to a layman in science it does not seem that any proof of such

decadence has been offered except the diminished attendance at certain meetings. But is this a proof of decadence, or merely of increasing specialization? No one complains of the decadence of science in and about London, I take it; and yet nothing surprises an American in London more than the small numbers he meets at scientific societies, whose names are famous throughout the world. If I remember rightly, I heard one of the most eminent philologists in England, Mr. Alexander J. Ellis, read his inaugural address as president of the Philological society, in 1872, before about twenty persons, and I attended a meeting of the Anthropological society, with Sir John Lubbock in the chair, and not more than twenty-five present. When we consider that the most eminent popular lecturers on science, such as Tyndall and Tylor, lecture, or lectured in 1872, to popular audiences of only two hundred or three hundred, it is evident that at the British capital the test of numbers can hardly apply. Across the channel it is still worse. At the Collége de France, in 1878, I heard eminent men lecture to audiences of a dozen, although Charles Blanc told me triumphantly that he always had auditors standing up when he lectured on the history of art in a hall holding perhaps fifty. My experience of German lectures is limited, but I was struck with the same thing there. Were I a man of science, it seems to me that I should advance the thesis that it is in the cruder period of scientific knowledge that it attracts large numbers, and that the tendency of specialization is to give 'fit audience, though few.'

Then there is another view which is in the nature of an *argumentum ad hominem*. Does not the very existence of *Science* refute the lamentations of *Science?* If scientific activity is greater elsewhere than in Boston and Cambridge, how came your valuable periodical to be established here?

T. W. HIGGINSON.

Cambridge, Feb. 22.

[Specialization of work is an increasing necessity of science, but wherever it begets absorption of interest, and this specialization of interest infects the whole body scientific, there science in any true sense will begin to show signs of decadence. It was not the small, but the decreasing attendance at Boston scientific meetings; not the attendance only, but the character of the communications made, — to which we drew attention.

As to the *argumentum ad hominem*, Cambridge was taken as the place of publication of this journal, merely from the accident that it was the residence of the editor chosen to conduct it. — EDITOR.]

Nadaillac's 'Prehistoric America.'

In the review of the American edition of Nadaillac's 'Prehistoric America' (*Science*, No. 108), there are two allusions calculated to produce a false impression, which it seems advisable to notice, as many of your readers may learn all they are ever likely to know of the book from your notice of it.

It is stated that 'quotations and references are incorrectly given.' In any book containing several thousand references, errors are almost certain to occur. Having, in the capacity of editor, to examine many of these references (for none of which I was responsible, as is explained in the preface), I have a much better knowledge of their average accuracy than the casual reader can possibly obtain, and can assure those interested that the person to whom the verification was intrusted performed that task in a way to which no reasonable exception can be taken; and the result is a considerable advance upon the original work, which, like most French books, was defective in this respect. Certain blunders appear in the index, of which no proofs were submitted to me; but they are, so far as I know, of a character to cause no difficulty to an investigator.

The second is a more delicate matter. There are many good persons to whom any comparison of religions which includes their own is painful. For these, anthropologists do not write. It is, I acknowledge, a painful surprise that my endeavor to indicate the kernel of spirituality in a husk of barbarous rites by a reference to a strictly parallel case within our own cognizance, should give offence to any scientific mind. Had I known, however, that this would occur, I should not, even then, have omitted an observation which is undeniably true, and which is necessary to a right understanding of a fundamental feature in the religions of Central America. My language was as follows: "It must be borne in mind, however, that the practice of cannibalism, in many cases was not a mere devotion to a diet of human flesh, but a rite or observance of a superstitious or religious character, not so far removed from the anthropomorphism which, in the middle ages, claimed for the chief Christian rite the 'real presence of body and blood' of the victim sacrificed for the welfare of the race." The inference of the reviewer, that one individual civilized Christian of our day (not to speak of half Christendom) partakes of the eucharist with a belief of mediaeval literalness, is, in my opinion, a libel upon humanity, and carries its own refutation. Such an individual, did he exist, would be no better than an Aztec, and entitled to no more consideration.

WM. H. DALL.

[In answer to the above, it may be said, 1°, that the statement in the editor's preface that 'many quotations have been verified,' is an admission that all were not, and that, if proof of this fact be needed, it can be found in mistakes like those on pp. 49, 51, 71, and 90, in which the accounts of the figures there given are incorrectly quoted; 2°, that transubstantiation is an essential article of faith in a church which numbers rather more than half the Christian world; and to assert that the sacrament of the eucharist as received by them is 'not so far removed' from the cannibalistic rites of the Aztecs, is an offence which is only equalled by the intimation that those who profess this belief in the actual presence, do not really mean it. In conclusion, the reviewer wishes once again to say, that, in spite of certain defects, "this is the best book on prehistoric America that has yet been published," and he takes pleasure in adding that much of this excellence is unquestionably due to the improvements made by the editor. — REVIEWER.]

The photograph of a Dakota tornado.

A photograph of the Dakota tornado, a woodcut of which appeared in No. 107, *Science*, was submitted to me last November, when the question of admitting it in the New-Orleans exposition free of charge for space, was under discussion. The sharpness of outline, and the fact that it was claimed that the photograph was taken at a distance of twenty-six miles, made me doubt its genuineness so much, that I submitted it to two of the best out-door photographers connected with the government surveys. Both pronounced it a manufactured photograph, most probably taken from a crayon-drawing.

J. W. GORE.

Chapel Hill, N.C., Feb. 26.

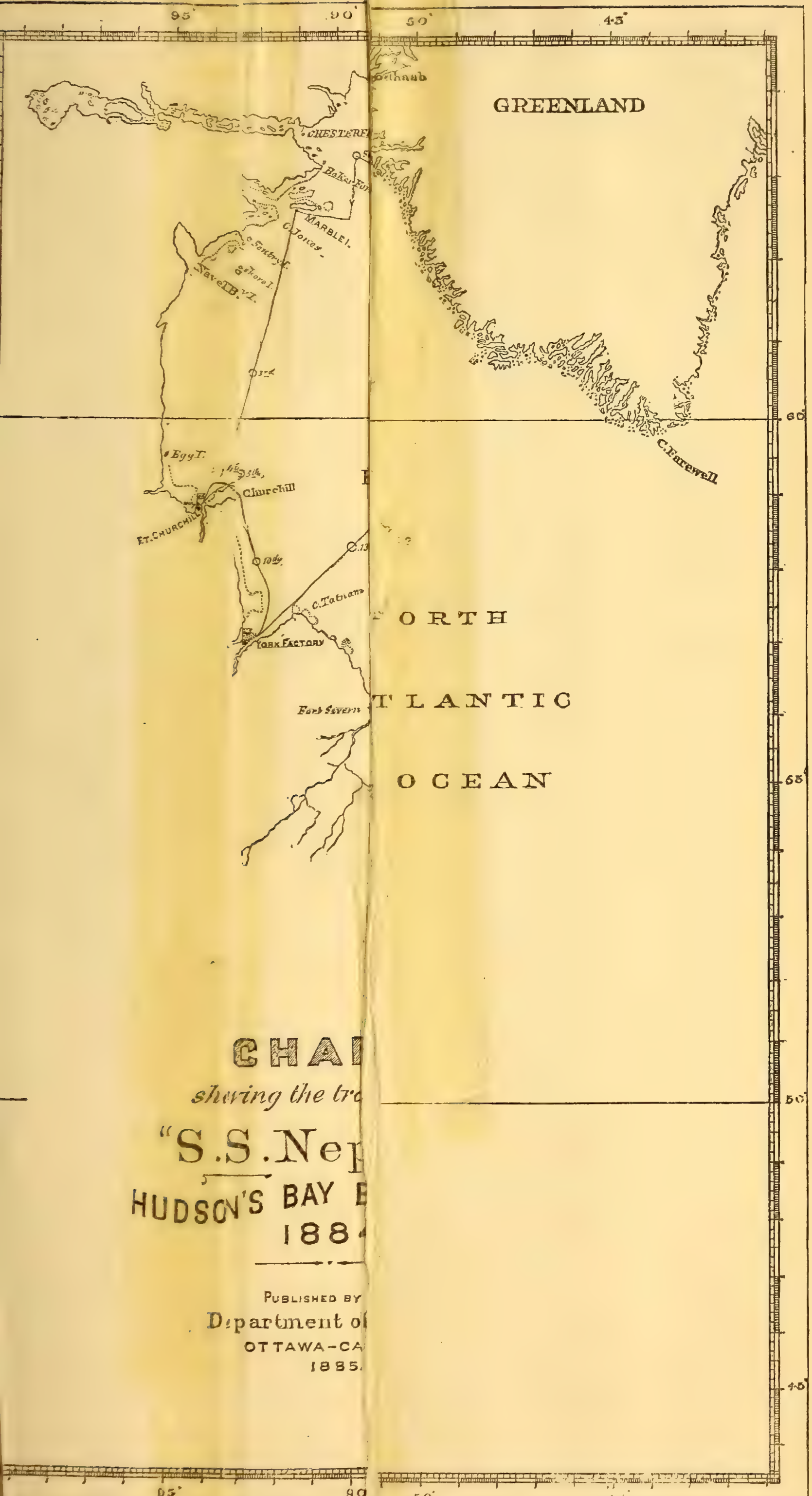

95°
90°
50°
45°
Gothnab
GREENLAND
CHESTERFIELD
Baker Lake
MARBLE I.
C. Jones
C. Fullerton
Navel B. I.
C. Farewell
60°
Egg I.
Churchill
FT. CHURCHILL
C. Tatnam
YORK FACTORY
Fort Severn
ORTH
TLANTIC
OCEAN
55°
CHA
shewing the tr
"S.S. Ne
HUDSON'S BAY E
188
PUBLISHED BY
Department o
OTTAWA-CA
1885.
50°
45°
95°
90°
50°


CHART
shewing the track of the
"S.S. Neptune"
HUDSON'S BAY EXPEDITION
1884.
Published by the
Department of Marine
OTTAWA–CANADA
1885.
HUDSON'S BAY
HUDSON'S STRAIT
FOX CHANNEL
ROE'S WELCOME
DAVIS STRAIT
GREENLAND
FROBISHER BAY
UNGAVA BAY
PORT BURWELL
LABRADOR
NORTH ATLANTIC OCEAN
JAMES BAY
Hamilton Inlet
NEWFOUNDLAND
GULF OF ST LAWRENCE
Anticosti
R. St Lawrence
Quebec
Montreal
Ottawa
NEW BRUNSWICK
NOVA SCOTIA
HALIFAX
Prince Edward I.
C. Ray
York Factory
East Main
Nain

Supposed crude jade from Alaska.

In *Science* for Dec. 19, 1884, there was given an abstract of the explorations on the Kowak River of Alaska by a party from the U. S. steamer Corwin, Lieut. Cantwell commanding. In this abstract it was stated that beds of a beautifully mottled serpentine were found in the mountains near the river, "as well as the so-called 'jade,' used far and wide for the most costly and elegant stone implements, which is perhaps the variety pectolite recently described by Clarke from specimens got at Point Barrow." It was also stated that 'Jade Mountain' seemed to be entirely composed of the green stone, about one hundred pounds of which were collected.

The collections on the return of the party were forwarded, as usual, to the national museum, as were also those made a little later from nearly the same localities by Lieut. Stoney's party. Both lots were referred to the writer for examination and report, and were found to consist largely of serpentine and a greenish gray quartzite, together with other miscellaneous material not necessary to mention here. The serpentine is mostly the ordinary green massive variety, though a few pieces of the columnar and fibrous forms picrolite and chrysotile are present. The quartz rock, which is doubtless the material mistaken by both parties for 'jade,' is light greenish in color, very fine grained, compact, and hard. Under the microscope, it is seen to be distinctly granular, but not perfectly homogeneous, containing innumerable exceedingly minute micaceous particles of a greenish color, and to the presence of which is doubtless due the color of the stone. There are also present many minute colorless needlelike crystals too small for accurate determination. Its specific gravity, as determined by a Jolly's balance, is 2.66, and a chemical test by Professor Clarke yielded 94.49% of silica. The rock is therefore radically different, not only from the Alaskan pectolite, but from any of the so-called 'jades' from any source that have yet been examined. An examination of the collections brought from Alaska has failed also to bring to light a single implement or ornament manufactured of this material : hence we must conclude that all the parties concerned were misled by the color and hardness of the stone, and that the true source of the so-called 'jade' is yet to be discovered. GEO. P. MERRILL.

National museum, Feb. 28.

'What is a microscopist?'

You seem to have run short of subjects for 'Comment and criticism' in your issue of Feb. 27, for otherwise I cannot believe that you would have written your ill-natured remarks upon 'microscopists.' If you had confined yourself to the definition of a microscopist as "an amateur who rejoices in the beautiful variety of microscopical specimens," I should have offered no protest; for I recognize in that definition a truthful, though only partial, description of a class to which it has long been my pleasure to belong. If you had been content to express your belief that the term 'microscopy' is a misnomer, and that the large and growing body of so-called 'microscopists' is not to be regarded as a division of the 'regular army' of science, I should still have held a humble and respectful silence, because I can see how such an opinion may be very honestly and very plausibly maintained. But your remarks call for a protest on the ground, that, instead of helping to a true estimate of the scientific spirit, they set up narrow and exclusive standards, and are essentially and offensively personal.

Microscopists, as far as they are mere amateurs and 'universal gatherers,' may perhaps not be entitled to more consideration than is due to 'camp-followers' and 'hangers-on;' although I think there is possibly a question as to your right to give them notice to leave. I am not sure but that I might argue, with some success, that many microscopists are more than amateurs, or that many recognized scientific specialists are, after all, only skilled microscopists; but why dispute over mere names? I am one of those who believe that in the most effective use of the modern microscope there are required a degree of technical skill and an amount of special knowledge which raise it to the rank of a distinct scientific pursuit. You, on the contrary, appear to look upon the microscope as you do upon the tweezers, the scissors, or the hammer, — as an instrument so simple that any student in any department may take it up without previous special training in its use, and obtain from it at once trustworthy results. But I beg to inform you, if you do not already know it, that, in the more delicate kinds of microscopical work, it is absolutely essential to employ expert methods in manipulation, and to apply very particular principles of interpretation, or else the conclusions are likely to have no value whatever. The exhibition of pretty things because they are pretty, and for the mere amusement of lookers-on, is no more microscopy than the making and administering of laughing-gas is chemistry.

But you seem to infer that microscopists are not properly scientific men, since they are not generally specialists; and the ground of your inference appears to be that such microscopists as you have happened to know have directed their attention to very various objects obtained from the different realms of nature. But might not the same criticism be made upon chemists, who analyze and weigh every sort of substance, — animal, vegetable, and mineral? Why is it more legitimate for them to rest their science upon a basis of molecular and atomic weights than for others to build a microscopical science upon a system of micrometric measurements? I should not quarrel with you if you urged the expediency of restricting the term 'microscopy' to a branch of physics, or even of optics, because we may all fairly differ about questions of classification; but, as things now are, I cannot discover the force of your objection to the recognition of microscopy as a division of general science based upon the fact that the subjects of its investigation are beyond the range of unaided vision in one direction, since astronomy, whose right to the name of a science you probably do not question, is founded upon the fact that the objects of its study are beyond unaided vision in another direction. In both cases, it seems to me, the science is conditioned by its instrumental requirements. In one instance it is the science of the microscope, in the other it is the science of the telescope. Why not object to astronomy because of its foundation in 'a common quality' of remoteness in space, or to paleontology as based upon 'a common quality' of remoteness in time?

But I have no intention of endeavoring to justify a claim on behalf of microscopists to be admitted to the sect of orthodox scientific men. I merely wish to speak a good word for the class as it now stands. I am fortunate in being acquainted with a number of cultivated and educated men, both amateur and professional, who make constant use of the microscope, either in the pursuit of their regular business occupations or in their private intellectual life, and who take pains to keep informed as to the improve-

ments being made in the instrument and its accessories, as well as in the methods of its manipulation and application. Some of them join with others of like predilections in organizations which are commonly called 'microscopical societies,' the purposes of which are mutual stimulation and the enjoyment and propagation of scientific — shall I say dilettanteism? — yes, if you like. At any rate, these gentlemen are engaged in very nearly the same kind of work that *Science* is engaged in; and many of them take your paper, and not only read it, but, when it presents subjects which they can illustrate or test by means of their microscopes, they undertake to see for themselves, and form their own conclusions. A smaller number of them even presume to make original investigations of one kind or another; and some of them actually add a new fact now and then to the great treasury of scientific truth, though it may often be such a little fact as not to attract much attention. I do not think they are usually men of great conceit; and I have never happened to come in contact with one who was over-anxious to be considered a 'regular' scientific man, or to receive any particular recognition by learned bodies. Generally speaking, I have found them to be gentlemen of simple and unpretentious devotion to nature, who had found themselves, somehow, endowed with a preference for those things which are invisible to the average sight, and who had imbibed the teachings of those who, like yourself, have advocated the popularizing of science.

But in this class are some who have earned and compelled recognition as men of science; and in London and in Brussels (to say nothing of home organizations) are microscopical societies of world-wide fame and importance, which have long been looked upon by some of us as bodies of scientific men. In their lists of fellows are such names as Dr. W. B. Carpenter, Dr. Lionel S. Beale, Prof. F. Jeffrey Bell, Rev. W. H. Dallinger, Prof. P. Martin Duncan, Dr. Henry VanHeurck, and many others whose scientific attainments speak for themselves, and no one of whom would disdain the name of '*microscopist*.' In our own country, I may with propriety mention one who has but recently passed away, and who, although possessing other claims to scientific eminence, achieved his greatest reputation and his most lasting fame in the field of pure microscopical manipulation. I refer to the late Dr. J. J. Woodward of the U. S. army, who was pre-eminently a *microscopist*, and who did every thing he could to promote and encourage the finest kind of technical and test work. His labors in that direction, with those of others of like proclivities and skill, have done more than all other causes to bring about the present wonderful perfection of the microscope objective. By the work and the demands of such manipulators, the great manufacturing opticians, like the late Mr. Spencer and Mr. Tolles, have been encouraged and stimulated to produce the latest marvels in optics, — the 'homogeneous immersion' lenses.

In view of the valuable services of such men as I have mentioned, I am at a loss to understand your arrogant assertion that 'scientific men have been very lenient towards the microscopists.' Is it to be understood that you are about to advocate some new standard of orthodoxy, or to put into operation some new formula of excommunication? Permit me, further, to inquire whether you really consider it unscientific to choose skilfully and neatly prepared specimens, carefully classified, neatly labelled, and systematically catalogued and stored? Is it amateurish to prefer a good and complete instrument to a cheap and imperfect one? Is there any particular virtue in working with poor tools when good ones can be obtained? Is there any thing unworthy in patience and painstaking? Is any thing in nature too small to be worth examination, or any fragment of knowledge too insignificant to pay for its acquisition? If you disclaim any such sentiments as these, why speak disparagingly of well-made 'slides,' of fine 'test objects,' of 'delicate diatoms' and 'podura scales,' of 'bits of tissue,' of 'polarizing crystals,' or, 'in short, almost any tiny scrap of the universe'? For when you talk so flippantly of these things, you certainly leave the impression on some minds that there may be matters so trifling and so tiny that they belittle the man who admires or studies them; and instead of promoting the general cause of science, as you profess to be desirous of doing, you cast in the way a stumbling-block of petty prejudice.

C. F. Cox.

New York, March 1.

THE SOLAR ECLIPSE OF MARCH 16.

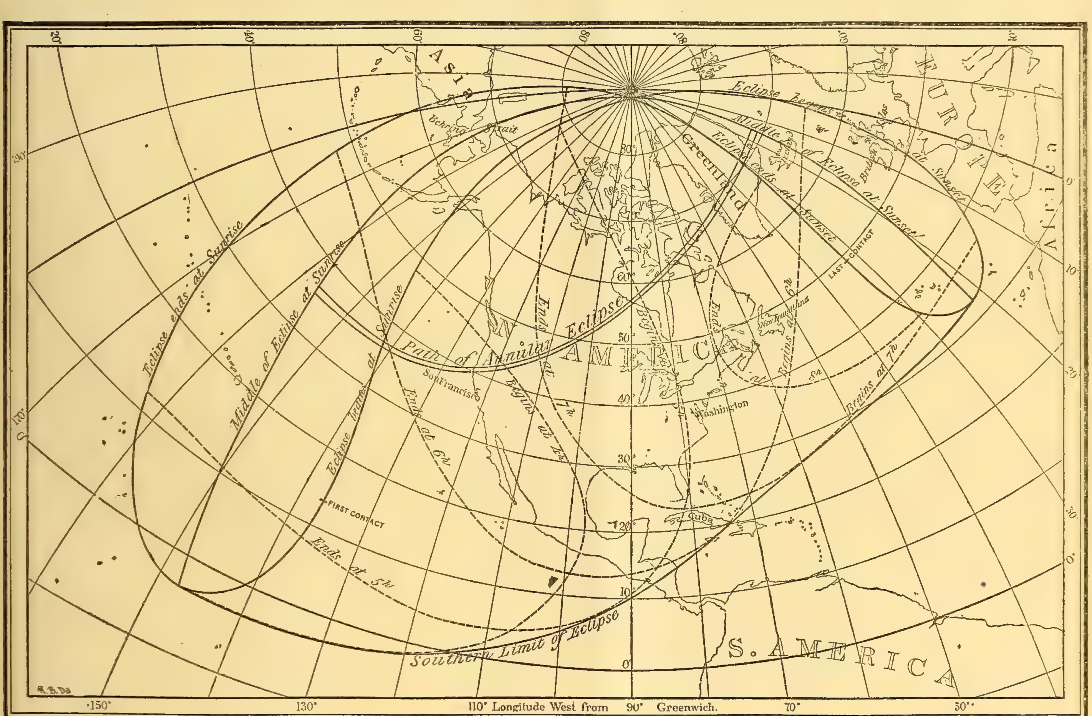
ATTENTION has already been drawn to the chief circumstances of this eclipse in the *Science almanac*, or at p. 578 of the last volume of *Science*, where the times of beginning and ending are given for a large number of places in the United States. The annular phase will be visible only within the limits of a belt between thirty and forty miles wide, which lies over a very sparsely settled tract of the North-American continent, and which is difficult of access at this season of the year. In the United States generally, the eclipse will be visible as a partial one on the afternoon of the 16th in the eastern states, and in the forenoon in the western.

Regarding the cycle of eclipses called the Saros, this eclipse is a 'return' of the annular eclipse of the 22d of February, 1849, visible almost wholly upon the North Pacific Ocean, the track of the annular phase skirting the eastern shores of Japan; also of the annular eclipse of March 5–6, 1867, which was visible as a partial eclipse over almost the entire European continent, and the greater part of Africa and Asia; the central line of annular phase running through northern Africa, crossing the Mediterranean and southern Italy, Russia and Siberia, and which was observed at a large number of European observatories. The next return of the eclipse following the present one will occur in the latter part of March, 1903.

Annular eclipses are usually regarded as a useless and insignificant sort of celestial phenomenon, and astronomers in the past have given very little attention to the observation of them. In comparison with the imposing spectacle of a total eclipse of the sun, an annular

eclipse is doubtless entitled to interest the average observer but little; however, it is quite possible that the rapid development of the means of eclipse research may in time lead to the utilization of annular eclipses with quite the same regularity that total eclipses are at the present day observed. In so far as we have learned, astronomers have made no preparations for observing this eclipse within the belt where the annular phase is visible.

The notion that an annular eclipse is an indifferent species of occurrence has certainly been helped along by the deceptive way in which these eclipses are almost always represented in astronomical treatises, where the ratio of the semi-diameters of the sun and the moon are unnecessarily out of proportion; and frequently that of the moon is drawn only three-quarters that of the sun, thus giving the impression that a very large proportion of the total light of the sun is unextinguished at the time and place of central eclipse. In point of fact, the greatest breadth the annulus can have, under the most favorable circumstances, is only about a minute and a half of arc, or less than one-tenth the semi-diameter of the sun at the time; while not infrequently — as is the case with the annular eclipse which occurs on Monday next, when the moon's semi-diameter is only one-thirtieth part less than the sun's — the eclipse which is put down in the almanacs as annular, only barely escapes being total. It seems very possible that a strongly developed corona might be observed on such occasions: indeed, the experience of many observers who have followed the corona after the total phase, makes it quite probable. To be sure, the duration of the annulus at such times is very short; but, if the corona could be observed on these occasions, we should be able to halve the intervals of an observation as conducted by the present methods at the times of total eclipses only.



ANNULAR SOLAR ECLIPSE OF MARCH 16, 1885.

THE ANNISQUAM SEASIDE LABORATORY.

WE have in America two classes of summer schools of natural history, — one in which only original investigators are allowed to study (Professor Agassiz's laboratory at Newport, the Fish-commission laboratory at Wood's Holl, and the Johns Hopkins laboratory at Beaufort, being examples); the other where students of

all grades, both beginners and specialists, are admitted. The Massachusetts laboratories at Salem, Cottage City, and Annisquam, are examples of this class; and these differ among themselves. Those at Salem and Cottage City have been conducted on the plan of giving lectures, and supplementing them with laboratory work. They have had little success; and, in fact, that at Salem has been closed for two years, because of small attendance, and lack of funds, for it can readily be seen that the lecture system is an expensive one. The laboratory at Annisquam has a distinct policy, due to Professor Hyatt's and Mr. Van Vleck's experience, much simpler and less expensive. No lectures are given, and no classes formed. The fundamental consideration in each case is the individual wants of the pupil. The student is set at work upon some special animal or in some line which he wishes to follow, and made to study and see for himself, frequently without the aid of text-books, which are seldom used except as means of confirming what has already been seen without their aid. Students not infrequently come from schools and colleges where the old method of teaching from books is still in vogue; and though imbued with the idea that this is the proper way of teaching, and at first opposed to the new method, they eventually go away with their notions concerning teaching always much modified, and sometimes completely revolutionized. That this is the proper method of teaching biology, there can be no doubt; and the amount of knowledge possessed by the students at the end of the season's work is remarkable indeed. Advanced students are allowed to choose their specialty, and study what they please; though they, too, are advised to study after this method.

The Annisquam school is the outgrowth of a small private laboratory which Professor Hyatt had in his own house at Annisquam. The number of applicants increased to such an extent, that the limited accommodations at Professor Hyatt's disposal would by no means satisfy the demands. Some of the members of the Woman's educational association of Boston who were interested in this branch of education, and knew these facts, took the matter in hand, and, though uninfluenced by any direct solicitation from Professor Hyatt or others, offered to found a laboratory for the use of both sexes, provided its departments of instruction could be carried on by the officers of the Boston society of natural history, of which Professor Hyatt is curator.

Annisquam, the place chosen, is an extremely pretty and quiet village on the north side of Cape Ann, a few miles from Gloucester, and two hours' ride from Boston by stage and rail. The granite, surf-beaten shores and the bowlder-covered granite hilltops are found on all sides. All conditions necessary to the existence of a variety of marine forms are present on these shores. There are tide-pools, rocks, mud, sand, eel-grass, and marshes, all alternately covered with water, and exposed to the collector, by the strong tides which rise and fall from nine to eleven feet twice each day. All kinds of shore and surface forms are found in an abundance equalled by no place south of Eastport. Embryos and adults of common and curious forms are constantly met with, thus furnishing material both for general work and original investigation. For collecting-purposes, the laboratory owns two row-boats, in which the students can visit any of the collecting-grounds in the vicinity. It has also been the privilege of the students, for the past four years, to make occasional dredging-trips in Professor Hyatt's schooner-yacht, though this does not belong to the laboratory. These excursions are not promised as an inducement to draw students; but it has been Professor Hyatt's custom to take the students out as frequently as they desire to go, and give them opportunities for dredging in proportion to their interest in this kind of work, whenever the Arethusa is at Annisquam. Dredgings are then made in from fifteen to fifty fathoms, and many interesting animals are added to the students' collections, besides the new forms which are thus furnished them for study.

Like most laboratories, this one is far from prepossessing, either from an external or internal point of view. The foundations are of solid granite. Most of the tables are fastened directly to the wall to allow microscopic work to proceed with little jarring. Each table is furnished with a small glass aquarium fed with salt water flowing from a tank which is filled by a windmill. The pipes from this are all wooden, so that there is no trouble with iron-rust. In the centre of the room are larger aquaria. There is also a photographic room, an attic, and a basement for storage. There is a good collection of chemicals, even those for fine microscopic work being well represented.

The school is open to all who intend to make use of the knowledge they obtain in teaching or in original investigation. The charges being merely nominal, those of limited means are not excluded by exorbitant fees; and the only obstacle of a pecuniary nature is the necessarily high board at seashore places. A few investigators have already made use of the

laboratory; and the best tables and facilities are reserved for any of this class who may select Annisquam in order to pursue their work in any special department, whether botanical or zoölogical. For the four years the average attendance has been sixteen. Last year there were, in all, fifteen, but at no one time more than twelve. There are comfortable accommodations for about eighteen persons when all the seats are filled, and this is considered the extreme limit in numbers at any one time.

The students come from all parts of the country east of the Rocky Mountains. Professor Hyatt is the director, and has one assistant; and neither receives any remuneration for his special services. A building specially constructed for a laboratory is much needed, as well as a steam-launch in which to make surface-towings, — a class of work little carried on in our waters, but the value of which should not be underrated. For the successful maintenance of this laboratory, it should possess a regular fund; for some fear exists that the Woman's association may at an early date withdraw its support. This would be sincerely regretted; for the Annisquam laboratory has marked out for itself a course, which, with proper support, will result in great advantage to American science. As it is, the ladies of the Boston association may well be proud of their beginning, and they may be sure that they receive the thanks of a large class of students who have profited by their venture.

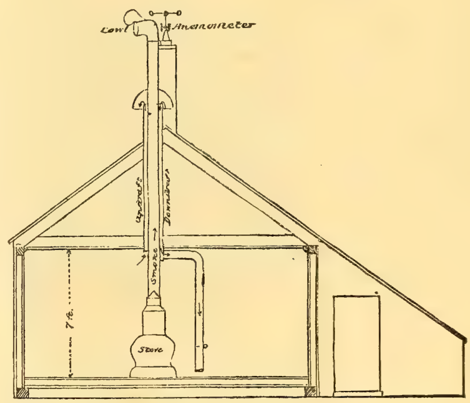
THE HUDSON-BAY EXPEDITION OF 1884.

WITH Manitoba, and the Canadian North-west beyond it, promising to become a vast wheat-producing country, a convenient outlet for surplus grain is most important. Taking Winnipeg as the converging point of all grain to be shipped, we find that the distance to Montreal by the shortest road, the soon-to-be-opened Canadian Pacific railway, will be fourteen hundred and thirty miles, and thence by water to Liverpool, *via* Cape Race, twenty-nine hundred and ninety miles; while if that large inland sea, Hudson Bay, could be utilized as part of a continuous water route to Europe, it would involve only seven hundred miles of rail transport to York Factory, and twenty-nine hundred and forty-one miles of water to Liverpool.

That the bay and strait are navigable to a limited extent is proved not only by the voyage of the intrepid navigator who bequeathed his name to them and left his body on their shores, but by the fact that the Hudson-Bay company has had ships sailing from England to York Factory annually for a great number of years, to take in all the supplies required in its western trade. But the voyages of these vessels, entering the bay only once a year, at the most favorable season, could throw little light upon the extreme duration of navigation; nor could American whalers entering the bay add much to our information, as they winter and pursue their avocation usually altogether too far to the northward.

The desire for further information on this important subject culminated in the appointment of a committee of investigation by the Canadian house of commons during its last session, and the appointment of an expedition under the command of Lieut. A. R. Gordon, a retired naval officer, and assistant director of the Dominion meteorological service. The plan adopted was to establish on the shores of the strait six observing-stations, — one on each side of the outer entrance, two similarly situated at the inner entrance, and the third pair dividing the distance between these, as stated briefly in No. 78 of *Science*.

A Newfoundland sealing-steamer, the Neptune, was chartered to convey the expedition; and, on the outward voyage, four stations were located: viz., at Port Burwell, on the north-western shore of Cape Chudleigh, at the entrance to Ungava Bay; at Ashe



SECTION OF OBSERVERS' HUT.

Inlet, near North Bluff, on the island called by Lieut. Schwatka Turenne Island; at Stupart's Bay, about three miles away from the strait, along the north-west coast of Prince of Wales Sound; and at Port DeBoucherville, on Nottingham Island, near its most southerly point. Each of the stations was named after the observer stationed there. The steamer then ran across Hudson Bay to its north-west angle, and visited the whalers' harbor on Marble Island, where a letter was found from Capt. Fisher, of the whaling-bark George and Mary, dated the 7th of August, stating that they had experienced a very cold winter and spring, with the thermometer four degrees below zero on the 23d of May; that the ship had got out of her winter quarters on the 7th of June, but had been unable to get up the Welcome or to the east shore in consequence of ice.

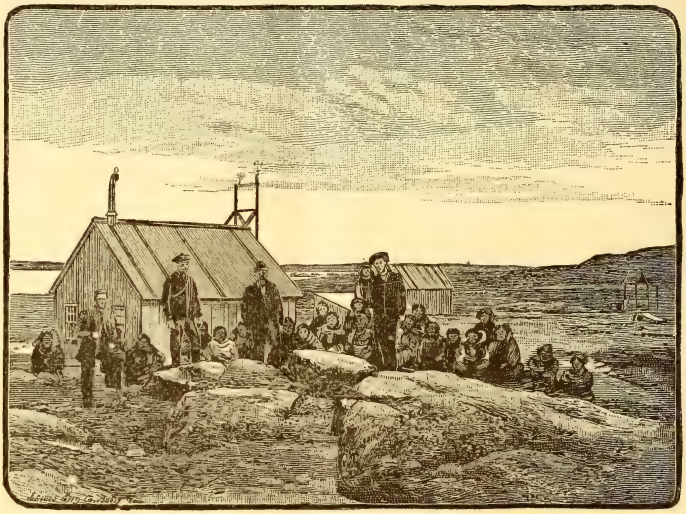
Continuing her voyage, the Neptune visited Fort

Churchill, where arrangements were made with one of the Hudson-Bay company's officers for taking auxiliary observations; thence to York Factory, where, in consequence of shoal water, the steamer was obliged to anchor eighteen miles from the post,—a fact likely to prevent this most important station of the Hudson-Bay company from attaining commercial importance. At this place there has been for some years an observer in connection with the meteorological service, and nothing more was required than comparison and adjustment of instruments. From York Factory the return trip was begun on the 12th of September, and a fifth station was established on the south-western extremity of Digges Island, where a good harbor, named Port Laperrière, opposite to, and forty-five miles from, Port De-Boucherville, was found. The vast stretches of ice encountered in this end of the strait point to these two stations as of the highest importance. There remained now but one station to establish, which had been intended for Resolution Island or the lower Savage Islands. On both trips this neighborhood was carefully examined, but no harbor could be found; and the station was consequently fixed at Skynner's Cove, on the north side of the entrance to Nachvak Bay,—a position apparently not calculated to aid materially the objects of the expedition.

At each of the six stations an officer is in charge, with two assistants. For their accommodation a hut sixteen by twenty feet, divided into three rooms, with a porch and storehouse attached as a lean-to, was erected. It has double walls of board, with an outer and inner air-space formed by a sheathing of tarred paper; and it is intended to further protect it from cold by covering it outside with sods or grass, and, over all, with snow. For heating, a base-burner cooking-stove, with twenty tons of anthracite coal, is provided; and the smoke-flue of galvanized iron is ingeniously designed, not only to guard against fire, the misfortune most to be dreaded, but to provide, as well, an up-draught for foul, and down-draught for pure air, if required. Only twelve months' provisions were left; but they were selected as preventives of scurvy, and to give the greatest possible variety of nutritive food.

Meteorological observations are to be taken regularly throughout the year, at four-hour intervals, three of these times being synchronous with the series taken by the regular observers of the meteorological service.

After each observation, during daylight, the strait is to be examined with the telescope, and a record of its state written down *at the time*, including direction, and, when possible, velocity of tide, movements of any ice, and whether much broken up, solid field, etc. Each day the time and height of high and low water are to be observed, and, during the open season, the character of the tide noted for two days before, and three days after, the full and change of the moon. Detailed instructions for making these observations, and checking the zero-mark on the tidal-post, were given the officers.



OBSERVERS' STATION AT STUPART'S BAY.

In the official journal which is to be kept must be also entered any thing observed regarding the migrations of birds, seals, and walruses, the movements of fish, etc., and the growth of grasses, as well as the result of observations on the disputed question of the depth to which water will freeze during an arctic winter.

At Mr. Stupart's station, in addition to the work at the other posts, special observations of magnetic phenomena are to be taken, for which a suitable building is provided.

In working through the strait, especially towards its western end, the ordinary compass was so sluggish as to be almost useless, and in this contingency the Sir William Thomson compass card was found to work admirably.

No icebergs were met, nor were reports obtained of their occurrence, in the bay. In the strait a large number were seen, principally along the north shore, where many were stranded in the coves; but some were met with in mid-channel. Of those seen in the eastern end of the strait, some had undoubtedly come in from Davis Strait, passing between Resolution Island and East Bluff; but all of those met to the westward had come from Fox Channel, or perhaps from the still more remote waters connecting with it, all of which have a southerly current.

Observations made by Mr. Ashe from his station on Turenne Island showed that a berg coming in

sight from the westward would pass out of view of his station to the eastward in from three to four tides, this indicating an easterly set of upwards of ten miles a day.

The icebergs seen from the Neptune in Hudson Strait in August and September were not more numerous, and would form no greater barrier to navigation, than those often met with off the Strait of Belle Isle, where, and off the Labrador coast north of it, a great number were encountered on the outward voyage of the Neptune.

Ordinary field-ice was met with off North Bluff, on the 11th of August, which, though it would have compelled an ordinary iron steamer to go dead slow, gave no trouble to the Neptune; the mate on watch running the ship at full speed between the pans, rarely touching one of them. In Ashe Inlet the ice came in with the flood-tide, and set so fast that the Eskimo were able to walk off to the ship, a distance of three-quarters of a mile. Similar ice was found on the south shore, opposite, but none in the middle of the strait so far east. In proceeding from this point to Salisbury Island, long strings of ice were frequently seen; but, as their direction was parallel to the course, the vessel coasted round them. The Eskimo reported that they had never seen the ice hang to the shores so late in the season, and that at all points there were unusually great quantities. On the homeward voyage none of this field-ice was seen.

Off Nottingham Island the ice got so heavy and close, that the attempt to force the ship through it was given up, after one blade of the propeller had been broken off, — an accident that entailed a delay of three days to fit in a new fan. In this ice, too, were seen four vessels, fast in the channel to the southward; one of them being the outgoing Hudson-Bay company's vessel, and another an American whaling-schooner. This ice was of an altogether different type from that hitherto met. Some of it, left dry at low water, was over forty feet in thickness, — not field-ice, thickened by the piling of pan on pan, but a solid blue sheet of ice, which had evidently been frozen just as it was found. The average thickness of the ice passed through, in the neighborhood of Port De-Boucherville, was upwards of fifteen feet.

From the reports of the Hudson-Bay company's ships, the evidence of Capt. Fisher's letter above quoted, and the experience of the Eskimo encountered, the conclusion is reached that 1883 and 1884 were exceptionally severe seasons, and the navigation more than ordinarily interrupted by ice; but the average of many years' observations at Fort Churchill, the only known harbor on the west coast of the bay, shows that the middle of June and the middle of November would be the extreme limits of time during which approach to that coast would be possible; and these limits agree closely with those of the open season in Nachvak harbor, on the Atlantic coast.

If the Neptune had been running direct from Cape Chudleigh to Churchill, instead of coasting, it is considered that she would not have been delayed by ice more than forty-eight hours; but no ordinary iron steamship, built as a modern freight-boat is, could have got through the heavier ice met, without incurring serious risk, if not actual disaster.

From the resident factor at Churchill it was learned that the bay never freezes so far out but that clear water can be seen. From the greater heat of the water, the absence of icebergs at all seasons, and the absence of field-ice on the voyage, even at Chesterfield Inlet, in the extreme north-west corner of the bay, it is evident that the bay itself is navigable for a much longer period each season than the strait.

Some high tides and heavy currents were noticed. During two days in which the Neptune was lying-to off Cape Chudleigh, in fog, she was set forty miles to the southward, which indicates the necessity for caution in approaching the strait in thick weather. At Port Burwell the rise of spring tides is nineteen feet, with a current of about four knots in Grey Strait, which causes, when the wind is adverse, an ugly sea. At Ashe's Inlet there is a rise of thirty-two feet, with a strong tide-race, and a current sometimes reaching six knots within three miles of the shore. At Fort Chimo the rise of spring tides is thirty-eight feet and a half. At Stupart's Bay there is a rise of twenty-eight feet; but the currents are not so swift as on the opposite shore, probably because the water is shallower.

Complete meteorological observations were taken on board the Neptune during the voyage, which when afterwards compared with those taken during the same period at Belle Isle, — a station of the meteorological service in the regular summer trade route between Quebec and Europe, — showed that during August and September the weather of Hudson Strait, so far as affects navigation, compared favorably with that of the Strait of Belle Isle; there being eleven heavy gales at the latter place against three in the former, as well as more than double the amount of fog.

Lieut. Gordon, in concluding his report, urges, that, as observations of one year will probably not give a fair average, the stations should be continued for a second year, and two or three of them even for a third year; that next year's expedition should leave Halifax by the middle of May, and relieve the stations, or, if the ice prevented this, the ship should push on and investigate once for all the condition of the ice in the strait and bay in the early part of the season. If the stations could be relieved, an effort should be made to reach Churchill by the opening of navigation there, — about the 15th of June; then a running survey should be made on the east coast, some deep-sea dredging and sounding done, and beacons erected on the low-lying shores of Mansfield and Southampton islands. This would allow the ship to reach the strait again by the middle of August, when any spare time could be employed in surveying it more accurately; or as an alternative, the fishing, especially the whaling in Rowe's Welcome, which is becoming of some importance, might be investigated with a view to proper regulation of the trade.

Wm. P. Anderson.

GEOGRAPHICAL NEWS.

Paul Fauque has returned to Paris from a scientific mission to Sumatra, with much valuable information touching the people of the country of Siaks and the kingdom of Atcheen. In the course of the journey he obtained precise information in regard to the causes and incidents of the death of Messrs. Wallon and Guillaume, assassinated by the natives on the river Tenom in 1880, as well as on the mineralogy and natural history of this great island. Numerous photographs of the country and people were secured.

François Deloncle, accompanied by an English and a French civil engineer and a Siamese commissioner, has been engaged in an inquiry as to the possibility of cutting the isthmus joining the peninsula of Malacca to the mainland, in north latitude 7° 14′. Here they discovered a little independent state called Samsam, formerly the resort of pirates, and now semi-independent of Siam. The inhabitants are a *métis* of Malay and Siamese blood. Here deep inlets penetrate the coast, joining an inland sea, which was now first seen by Europeans. It is about twenty feet deep, and forty-five miles long, having a greatest width of twelve miles. It presented a very singular appearance, being plentifully strewn with small islands of compact limestone covered with swallow's nests. This sea is fresh during the north-east, and salt during the south-west monsoons, and separates the island of Tantalam from the peninsula by a multitude of passages not represented on any chart. The section of the peninsula was made at Talung; and specimens brought back show the presence of auriferous quartz, tin, and iron. The report of the expedition will contain important anthropological as well as geographical documents. Returning, Deloncle also examined Adam's Bridge, between Ceylon and India, and will report that the establishment there of a maritime passage is entirely practicable.

Sorokin has recently published an account of his journey in the central range of the Thian-Shan, where, among other discoveries, he found the so-called ruins of cyclopean buildings to be due to natural causes acting on rock *in situ*. Dr. Regel has returned to Tashkent with his collections from Hissar and Karategin.

Les missions catholiques, published at Lyons, contains in almost every number rich contributions to geography or ethnology, as well as to the history of missions. Among others, it has recently contained the itinerary and map of a journey across Kwangsi and Kong Cheo, by Father Chouzy, and a journey on the Niger, by the missionaries of the church in Africa. The abbé Desgodins, in the same review, announces his establishment in a new English outpost in Thibet, at Pedong, forty-five miles north-north-east from Darjiling, where he will continue meteorological observations, as previously at Bathang, his former station.

Giraud, to whose critical situation, abandoned by his caravan, recent reference was made in this journal, has arrived safely at the mouth of the Zambezi. It appears, that, after leaving Karema, he endeavored to penetrate westward, in spite of disquieting rumors and symptoms of mutiny in his caravan. He succeeded in crossing the lake in native canoes, and in a month had reached the Belgian station of M'pala. Here, unsettled by rumors of difficulty on their proposed route, his party revolted, and proceeded to pillage villages where he had previously been received with kindness. He was therefore compelled to return. With a small party gathered on the shores of Lake Tanganyika, he reached the north coast of Lake Nyassa, descended in a little boat to Shiré, endangered by the hostilities between the Portuguese and the natives, but succeeded in reaching the Zambezi and Kwillimané in safety, in good health, with numerous notes and collections, and, at last accounts, was on the point of returning to Europe.

From the *Missionary herald* for March we learn that Mr. Richards of the East-central African mission made a journey in October, 1884, from Inhambane to the Limpopo River. He went through an unexplored country in search of a tribe whose chief settlement was reported to be Baleni on the Limpopo, and who spoke a language akin to Zulu. Between thirty and forty miles westward from the coast he crossed a river called the Bombom, which may be the Luizi of some charts on which it is represented some three times the distance from the coast. No other important river was noticed until the Limpopo was reached. The country is almost wholly marshy, and covered with brush or low palms, with ponds here and there. The thermometer ranged between 80° and 90° F. The Amakwakwa tribe, encountered forty miles from the coast, had been subjected to chronic pillage by Umzila's fighting men, and had abandoned agriculture in consequence. They were idle, living on the wild fruit which is abundant, and getting very drunk on the native wine afforded by the scrub palm, which produces a rapidly fermenting sweet sap at the rate of a pint a day per tree. Many kraals were deserted, and a tract of country seventy-five miles square was nearly desolate. About a hundred and fifty miles from the coast, the Amagwaza people were encountered, who gave the travellers a cordial reception as soon as it was found they were not Portuguese. They are subject to Umzila, whose capital kraal is far to the north, but most of whose people live south of the Sabi River. Baleni was said to be on the Limpopo three days south from the point where Mr. Richards reached it. Time did not suffice to visit it. The return was made through a rather openly wooded country, where the trees bore long wreaths of a gray tree-moss, and beautiful birds were abundant. Elephants abound in this district. In three days the ridge between the Limpopo and the sea was reached, where live an industrious kindly people, with sheep, cattle, and large gardens. By the pedometer the crest was fifty-seven miles from the sea, and seventy-eight from the river. The people of the region appear to have been originally of Tonga race; but, conquered by the Zulus and Portuguese, their language has been modified by the superior nationality in its respective districts.

The long-disputed questions as to the ancient bed of the Amu Daria, or Oxus, appear to have received a final settlement in the publication of the studies of Konshin of St. Petersburg. According to him, the river has never directly emptied into the Caspian; but it is probable that at some period an indirect communication has existed between them through Sari-Kamich Lake and the Uzboi, which drained it. The lake was of much greater area, and its overflow reached the Caspian by the Uzboi: its character was saline or brackish. Were this state of things restored, we should have an immense Turanian sea, composed of a northern basin corresponding to that of the Sea of Aral, and a southern one corresponding to the Sari-Kamich area, connected by a wide but shallow neck of water. Into the former the Sir-Daria would empty, with the Sari-Su and the Chiu; into the latter, the Oxus, the Tedient, and the Murghâb. The overflow of brackish water would find its way by the Uzboi to the Caspian.

Those interested in the question of lakes with two outlets would do well to incite exploration of Frances Lake in the North-west territory. This lake, discovered many years ago by Robert Campbell, now of Winnipeg, was reached by him from the head waters of the Liard River, ascending, according to his account, a small stream actually proceeding from the lake. To his surprise, on the other side he found a communication, during the time of high water, with the head waters of the Pelly River. In 1865 information received from officers of the Hudson-Bay company at Victoria, by those of the International telegraph expedition, was to the effect that the Pelly communication was the chief one, and that a lowering of its bed had turned the drainage permanently north-westward, and the connection with the Liard had become nearly or entirely dry. This has since been indicated on most charts; but, as the lake covers some four hundred and fifty square miles, fuller and confirmatory evidence would be very desirable. The Liard is an affluent of the Mackenzie, and the Pelly of the Yukon River.

THE STATE SURVEY OF NEW YORK.

THE veto of the appropriation for this survey by the late governor of New York caused only a partial suspension of its functions. The survey exists by reason of an organic law creating the commission, and defining its powers. Only by the repeal of this law can the survey be abolished. Its work has been confined to a triangulation so accurately executed as to form a reliable basis for all local surveys and topographical work; but the value of such careful measurements is somewhat difficult for the unscientific man to understand, and the results are not immediately apparent.

To remove all doubts regarding the excellence and economy of the work under their control, the commissioners requested an investigation by the U. S. coast and geodetic survey. After a full examination of the records of eight years' work, Superintendent Hilgard transmitted them to the state authorities, with his full indorsement.

By this appeal to a most competent authority, the commissioners and director of the New-York state survey have established the fact that the work slowly accomplished with small appropriations since 1876 has been done in the best way and at a small cost. Their report just made to the legislature, having vindicated the work of the past, recommends a radical change in the future policy of the survey. It is urged that New York should be warned by the experience of Massachusetts that a triangulation not immediately followed by a detailed topographical survey gives but little satisfaction to the people. The citizens of a state want reliable maps which they can use, not mere skeleton maps which are only available for surveyors. The board therefore recommends that the legislature enlarge its powers, and increase the appropriations for the state survey, so that topographical surveys may be at once begun in at least three counties, and be carried forward on such a scale as to permit of the economical performance of the work. The cost of the topographical work is estimated at from ten dollars to twenty dollars per square mile, depending upon the character of the country, and the scale of expenditure recommended is forty thousand dollars per annum. For this sum, complete maps of from three to five counties could be made each year, and the maps, by counties, issued within a year after the field-work is done. It is proposed to have the U. S. coast and geodetic survey complete the primary and secondary triangulations, leaving the funds of the state to be used for tertiary triangulation and topographical work.

The experience of the director of the survey, who is by law the engineering member of the state board of health, has proved conclusively the wide-spread need of topographical maps to aid in the sanitary work of the state. The commissioners therefore affirm that there is pressing necessity for topographical maps for sanitary works on water-supplies and drainage; that no survey can meet the wants of the people that does not result in a reliable map sufficiently detailed for ordinary practical and scientific purposes; and that the people have a right to expect that the benefits of the survey will be made immediately available in the form of useful maps.

PROPOSED NEW METHOD OF MEASURING THE DENSITY OF THE EARTH.

THE only known way of measuring the density of the earth is through the 'gravitation constant,' which expresses the attraction exerted by a known mass at a given distance. The bodies whose attractions have been measured are either mountains or portions of the earth, as in the well-known experiments of Maskelyne and Airy; or portable masses of lead, as used by Bailey and others. The difficulty in the way of the former experiments is the necessary uncertainty of the density of those portions of the earth's mass in

and below a mountain, or within any other extended region. The difficulty in the way of utilizing the masses of lead is the extreme minuteness of the attraction exerted by any manageable mass. On the whole, however, the latter method, in the hands of Bailey, Reich, and others, has been the more reliable of the two. A few years since, the late Professor Von Jolly of Munich undertook to measure the attraction of a globe of lead about one metre in diameter, upon a weight in the pan of a balance. The arm of the balance was at a height of twenty-one metres over the leaden globe, and the pan which held the weight was suspended by a wire of that length. It was balanced by a weight in the other pan immediately below the balance, so that the attraction was exerted only upon one weight.

A modification of Jolly's method was recently described in a paper read before the Berlin academy of sciences, by Arthur König and Franz Richarz. These gentlemen propose the following modification of the long suspension. They will cast a great block of lead in the shape of a parallelopiped. On the horizontal surface of this block will be placed an ordinary balance, the scales of which shall swing very near the surface. A vertical hole will be bored through the block, directly under the point of suspension of each scale of the balance; and a second pair of scale-pans will be suspended below the block by wires attached to the upper scale-pans, and passing through these openings. Thus the balance will consist of two pairs of scale-pans, — one pair below, the other above, — with the leaden mass between them. The masses whose attraction is to be measured will be placed, the one in the upper, and the other in the opposite, lower, pan of the scales. The attraction of the block will make the lower one lighter, and the upper one heavier. The positions will then be changed by removing the weight in the lower pan to the pan immediately above it, and *vice versa*. Then the attraction of the block will make heavier the weight which was before lighter, and *vice versa*, thus causing a difference in the weights amounting to four times the attraction of the block.

It is proper to add that this weighing method is subject to a good deal of criticism. So far as we are aware, its original inventor was Mr. C. S. Peirce, who proposed to utilize the Hoosac tunnel for the purpose, — to bore a hole from the surface of the earth vertically to the tunnel, and use it for the passage of a wire to hold a weight supported by a balance at the surface. It was found, however, that the air-currents, and other sources of disturbances, were such as to render the method inapplicable. It is difficult to see how Von Jolly's apparatus could have been free from the same difficulty. The attraction of his leaden sphere could only have been one five-millionth part of the weight, — a fraction which is about the extreme limit with which it is possible to effect a weighing under the most favorable conditions. With a block of any manageable size, the attraction by the method of König and Richarz will hardly reach a millionth part of the weight. Still the authors are making arrangements to execute their experiment, and physicists will look with interest for its result.

THE PREHISTORIC CONGRESS AT LISBON.

THE prehistoric studies in Portugal of the late lamented Carlos Ribeiro have already been brought to our readers' notice (*Science*, Dec. 14, 1883). He was the leading spirit at the Lisbon congress, as well as its general secretary; and his long illness dating from that time, and his death, which took place Nov. 13, 1882, account for the delay in the appearance of this long-expected official report. It has now been given to the world in the most satisfactory manner, with beautiful typography and ample illustrations, under the charge of Sig. Delgado, who has succeeded to the position of director of the Geological bureau of Portugal. The freshness of it, however, is somewhat impaired, owing to the full *résumé* of the proceedings, that was given by Cartailhac in the *Matériaux*, November and December, 1880, and by Professor Bellucci, at even greater length, in *L'archivio per l'antropologia, e l'etnologia*, vol. xi. fasc. 3.

It was understood that the chief interest of this congress would centre about the discussion of the first question proposed: "Are there any proofs of the existence of man in Portugal during the tertiary epoch?" Ribeiro and the Portuguese geologists desired that foreign geologists and prehistoric archeologists should visit and thoroughly study at least one of the localities from which the supposed tertiary flints had mainly come. All this was accomplished, and the results are already well known. An excursion (somewhat of the nature of a picnic) was made to 'the desert of Otta,' about thirty miles north of Lisbon, where Professor Bellucci of Perugia found *in place*, in a miocene deposit, a flint flake with a well-marked 'bulb of percussion.' This was seen by several witnesses before it was detached, and by many experts was pronounced to be of undoubted human origin. To the writer, however, the engraved figure of it does not appear entirely convincing. Upon their return, the series of flint objects discovered in this locality by Ribeiro, during the past twenty years, was submitted to the judgment of a commission of nine experts. Their report, and the discussion that ensued thereupon, developed a great difference of opinion. Upon the geological question all were in accord with the Portuguese geologists, that the locality was the shore of a miocene lake. In regard to the archeological

Congrès international d'anthropologie et d'archéologie préhistoriques. Compte rendu de la neuvième session à Lisbonne, 1880. Lisbonne, *Typographie de l'Académie royale des sciences*, 1884. 49 + 723 p., 44 pl. 8°.

problem, many refused to admit the human origin of the flints; among them John Evans, whose competency to pronounce an opinion cannot be questioned. Of those who believed them to be the work of men, some thought that they were of more recent origin than the beds in which they were found. In their judgment, the flints came from the surface, and had been washed by floods into crevices previously existing in the miocene clays. Thus the question was practically left in the same condition in which it stood before: the sanguine believed that the existence of the *tertiary man* had been demonstrated, while the cautious waited for further evidence. We do not find in the report any thing essential added to the abstracts of the various arguments that have been previously published; and the editor apologizes for not having given any figures of the particular objects that served as the basis for discussion, on the ground, that, as Ribeiro had not made the necessary selection, he feared to do it himself, lest he might by chance omit some capital piece of evidence.

Many important papers in various departments of archeology, read before the congress, are here given at length, of which we have only space to allude to a few, especially such as relate to the antiquities of Portugal.

The publication of the careful account of the researches of Sen. Vasconcellos in the valley of the Douro, with the accompanying plates, will have a tendency to add Portugal to the list of the countries of Europe in which the quaternary gravels have yielded human implements. The objects found consist of a number of very rude quartzites of the St. Acheul type, which, however, some of the members refused to admit to be artificial at all. Thus far, no organic remains have been found accompanying them in this locality; but in a cavern at Furninha, near Peniche, on Cape Carvoeiro, Sen. Delgado has discovered a deposit of quaternary gravel, which had been introduced by a natural opening in the roof, and in this he found a fragment of a lower human jaw, together with a fine specimen of a flint axe of the St. Acheul type. These are all the instances given of the discovery of vestiges of the *quaternary man* in Portugal, although Sen. Ribeiro, in his opening address, alludes to them as having been made in the valley of the Tagus, in the district of Alemtejo, and near Coimbra.

One of the most interesting papers is Sen. Delgado's methodical and lucid narrative of his exploration of the cavern of Furninha, and of the discoveries made in it pertaining to the neolithic period. Great quantities of human bones were found, and many of them were broken, as if to extract the marrow, and calcined, precisely like those of animals used for food; so that the explanation of cannibalism at once suggests itself. But as pottery, polished stone axes, and other implements and ornaments were also found with them, Cartailhac stoutly maintained the theory that the cavern had been used as a place of sepulture. Although cannibalism has undoubtedly been practised by many modern savage races, its existence among the prehistoric peoples of western Europe is much disputed. An animated discussion upon this point, and a reference of the facts and arguments to a commission of experts, resulted in about an equal division of opinion.

Sen. Ribeiro gave an account of his exploration of kitchen-middens situated on the southern bank of the Tagus, about forty miles above Lisbon. The largest covered an area of some three hundred feet by a hundred and eighty, and was about twenty-one feet thick in its deepest part. The most remarkable circumstance connected with it was the discovery, in this restricted space, of no less than a hundred and twenty human skeletons, without any of the usual objects that accompany prehistoric interments. Not a trace of pottery was found, and such implements as were met with were of the rudest description, made of quartzite or flint and bone. Many bones of animals were scattered throughout the mass, but none of domestic animals except the dog. Like the kitchen-middens of Denmark, these seem to belong to the very beginning of the neolithic period. The study of the crania found in them, shows, according to Quatrefages, a type quite distinct from that of Cro-Magnon.

An entertaining paper by Sen. Pedroso gives an account of certain popular forms and customs in reference to marriage, still lingering in out-of-the-way villages in Portugal, which seem directly traceable to the ancient practices of polyandry and marriage by force.

The recent discoveries by Dr. Prunières in la Lozere, of several sepulchral caverns containing bones, in some of which stone arrowheads are still embedded, are briefly noted. As the crania are all purely dolichocephalic, it is a fair inference that we have here proof of a struggle between the early race of Cro-Magnon and a brachycephalic, neolithic race of dolmen-builders who were acquainted with the use of the bow, since the arrow-heads precisely resemble those found in the dolmens.

We regret that we have no space to allude

to any more of the many valuable and important papers contained in this handsome volume.

The parliament of Roumania, upon the plea of poverty, has declined to extend an invitation to the congress to hold its next session the present year at Bucharest, which the leading members, under the initiative of the Baron de Baye, had selected as the place of meeting. We learn, however, that arrangements have been made for it to take place at Athens in 1886.

HARTLEBEN'S LIBRARY OF ELECTRICAL TECHNOLOGY (ELEKTROTECHNISCHE BIBLIOTHEK).

THE admirable collection of treatises published under this title was originally announced to contain ten volumes; but the number issued has already reached twenty-six, and others are stated to be in preparation. Almost every subject relating to electricity receives attention, including telegraphy, telephony, electric lighting, and electroplating; while certain topics are very minutely discussed, as, for example, electrical conductors, electrical clocks, the medical uses of electricity, and its applications to military purposes. The various volumes, while necessarily somewhat unequal both in merit and in importance, are yet all of them of substantial value; and it is much to be desired that they may, in part at least, be translated into English for the benefit of that large class of readers who are desirous of securing information at once elementary and accurate. This has, indeed, already been done in the case of the initial volume of the series, — that on dynamo-electrical machinery, by Glaser-De Cew, which has been translated by Dr. Paget Higgs, and which, notwithstanding some minor slips, is by far the best treatise of its size upon the specific matters which it discusses. The treatise on instruments for electrical measurements, by Wilke, contains some interesting descriptions of special forms of galvanometers and electrometers; as, for example, the admirable dead-beat galvanometers with bell-shaped magnets made by Hartmann and other German makers, the special form of Thomson galvanometer made by Siemens & Halske, Kohlrausch's torsion electrometer, and Zöllner's bifilar electrometer. Zech's 'Elektrisches formelbuch' is of very high grade, and contains much information that is not easily found elsewhere in a collected form. Its topics are arranged alphabetically; and it contains, in an appendix, a brief electro-technical dictionary giving the equivalent electrical terms in German, French, and English. Its scope will best be indicated by a brief reference to a few titles selected almost at random. Under 'Bussole' we find a general discussion of the effect of a circular current on a magnetic needle, including the tangent, sine, and Helmholtz-Gaugain galvanometers, together with the cosine galvanometer of Professor Trowbridge; the latter assigned, however, to Obach and Denzler instead of to its real inventor. The article 'Dämpfung' gives a demonstration of the formulae for the damping of a magnet; and under 'Schwingung' there is given the derivation of the various formulae for vibrations, including vibration with damping and aperiodic motion. Another valuable work is that of Tumlirz on potential. Volume xx. of the library contains a bibliography of electricity from 1860 to 1883, with special reference to technical electricity. Among the more timely of the works relating especially to the industrial applications of electricity are those by Japing on the electrical transmission of power, and Krämer on electrical railways. The volume relating to multiple telegraphy not only contains the duplex and quadruplex systems, but also the multiple systems of Meyer, Granfeld, and Baudot are described at length. The American systems of Gray and Delany are not noticed, certainly a most unfortunate omission. The last volume issued, that on cable telegraphy, is the most comprehensive treatise on the subject that we know, and is particularly valuable, as works relating to it are so few.

RECENT GOVERNMENT REPORTS.

WE regret that we are obliged to note a decided degeneration in the Bulletin of the fish-commission. What might and should properly be one of our most important government reports each year becomes less valuable. The present volume, although it contains several important scientific contributions, is in the main made up of unimportant letters, of value to very few people so far as we can judge. The first hundred and fifty pages are entirely occupied by lists and tables by the editor, not one of which is of importance to any class of people. What, for instance, can be the possible use of "A list of the blank forms and circulars of the U.S. fish-commission," which alone takes up twenty-one pages? Judging

Bulletin of the U.S. fish-commission, vol. iii. Washington, 1883.

Report of the U. S. fish-commission, part x. Washington, 1884.

Annual report of the Board of regents of the Smithsonian institution, for the year 1882. Washington, 1884.

Proceedings of the U. S. national museum, vol. vi. Washington, 1884.

the volume as a whole, we are driven to one of two conclusions, — either that there is a lack of good editorial judgment in preparing the volume and accepting articles for publication, or else there must be a lack of good articles. That the latter is the case we cannot believe.

Of an altogether different type is the Report of the fish-commission. Its greatest fault lies in the fact that it is extremely bulky, being composed of over eleven hundred pages; but this fault is partly hidden by the value of some of the articles. Among the most valuable contributions contained in the appendices are those by Verrill and Smith upon deep-sea animals, and by Ryder upon the embryography of osseous fishes and upon the development of the oyster. There are other important articles by Collins, McDonald, and others. We notice that in many of these papers there is a decided tendency toward the use of more space than is necessary to set forth the ideas of the author. This tends only to swell to unwieldy proportions an already bulky volume. There are two articles — one by McDonald, the other by Smiley — the value of which we fail to see: they are simple lists of the people who have received carp from the commission. If these had been left out, together with the equally superfluous lists of lakes and rivers of the United States, the report would have been shortened by at least two hundred and fifty pages. The idea of separately paging the different articles, and furnishing them each with an index, is good.

In addition to the report of the secretary, a new and important feature, the report of the assistant director of the National museum, is introduced into the Annual report of the Smithsonian institution. The appendices, which have been introduced in the last three volumes under the title of 'Record of recent scientific progress,' are continued in this report. These are very good summaries, and are written by some of our most eminent scientific men; still we doubt if they are of any considerable value. The specialist in each branch treated must necessarily know as much as is contained in the article upon his own branch, and all are certainly too concise to be of popular interest. The idea, however, is excellent; and if the Smithsonian could each year publish separate bulletins, each one covering one of the branches of natural science, and if each one should be made to occupy several times as much space, and be written in a more popular style, we think that they would soon come to be recognized as the most important publications of the institution by all who are interested in the natural sciences.

The last volume of the Proceedings of the national museum shows a decided improvement over all the others. It is even richer in important articles than any previous one, such men as Smith, Bean, Jordan, Ryder, Gill, and Ridgeway, being among the chief contributors. A noticeable feature of this volume is, that among its list of contributors are the names of two women. This is a comparatively new feature in American science. The chief fault of the volume lies in the appendices, which are entirely out of keeping with the rest of the volume. Such articles as "Brief directions for removing and preserving the skins of mammals," although very valuable to young collectors, are out of place here. The volume for this year shows signs of careful editorial work; but the index could be improved by printing it in treble columns, to bring more under the eye at once.

NOTES AND NEWS.

Mr. Sidney Gilchrist Thomas, whose name is connected with the Thomas-Gilchrist patent for the conversion of phosphoric pig-iron into steel, died in Paris on Sunday morning, Feb. 1. Mr. Thomas, says the *Athenaeum*, was educated at Dulwich college, and was intended for the medical profession; but on the death of his father he entered the civil service. He was excessively fond of chemistry, and devoted all his leisure to the study of that science. In 1878 he read before the Iron and steel institute a paper on the elimination of phosphorus, in which he announced the discovery which he and his relative, Mr. Gilchrist, had made. The dephosphorization or basic process, as it is usually termed, renders available for the production of steel the pig-iron smelted from spathic and less pure ores of England. This process was thought so highly of, that Mr. Thomas was presented by the Iron and steel institute with the Bessemer gold medal. The labors of Mr. Thomas in establishing the basic process in Germany, where it is most extensively employed, in France, and in England, told severely upon a constitution always inclined to be delicate. A voyage to Australia, and a residence for some time in Algeria, appeared to give hopes of his ultimate recovery; but on his return to Paris he became worse, and on Sunday morning (Feb. 1) he breathed his last, at the early age of thirty-six.

— The Académie d'aérostation météorologique of Paris held a celebration, on the 15th of January, of the centennial of the balloon-voyage of Blanchard and Jeffries across the English Channel. On account of an accident, the *fête*, which was held at the seat of W. de Fonvielle, was postponed from the 7th, the actual date of the transit. It is now proposed to hold a celebration in the forest of Guines on the 25th of May, on the spot where the balloon landed, and where a monument has been erected.

— The *Annales industrielles* gives an account of the making of cork bricks, now being employed for coating steam-boilers, ice-cellars, etc. The cork is winnowed from impurities, ground in a mill, kneaded up with a suitable cement, and pressed into bricks; then dried, first in the air, and afterwards by artificial heat. They are not hard, and not liable to decomposition: they keep out moisture, heat, cold, and sound.

— The Russian government is preparing an expedition to western Siberia for the purpose of examining some sulphur deposits recently discovered there. The natives have for many years had knowledge of these deposits, but the government has only recently been made cognizant thereof, through a report by Lieut. Kalityn. The deposits are said to rival those of Sicily. In Russia, sulphur has hitherto been found only at Ichirkota, not far from Petroffsk in Daghestan, which has chiefly been delivered to the powder-mills.

— The Journal of the Iron and steel institute states, that with a view to lessen the noise caused by the trains crossing the railway-bridges in Hannover, Germany, due to the violent vibrations of the rail-joints, the original rails have been taken up, and steel ones, eighty-eight feet six inches long, laid down in their place. The new rails were manufactured at the Osnabruck steel-works, and the result of the innovation is in every way satisfactory.

— In the *Medical chronicle*, Dr. D. J. Leech discusses the properties of paraldehyde, a new stimulating sedative drug which is likely to take a prominent place in the pharmacy of the future. It is intermediate, apparently, between opium and chloral. It is well known that chloral has been freely used as an intoxicant, mainly because it leaves no after-odor, and may be taken without detection. Paraldehyde has the advantage, from one point of view, of presenting a distinct and easily identified smell. Dr. Leech speaks of having employed paraldehyde as an aid in breaking off the habit of opium-taking, and in helping a patient to pass through the miseries which followed the abrupt discontinuance of long-continued and large doses of morphia.

— The exhibition of metal work, to be held at the quaint old town of Nuremberg, is in a sufficiently forward state of preparation to show what it will be like. Berlin exhibits principally vessels, lamps, and bronze figures. England is badly represented, leaving the more space for Austria and France. On the other hand, Spain and Portugal show no modern work at all, but Italy is represented by several towns. America shows only work in aluminium. Japan has sent so much that a special commissioner has come with the goods. The Chinese war has prevented many exhibits from there. Turkey and Persia send a great deal, Greece nothing. Other countries have sent national ornaments.

— Every one has noticed that the sun and moon, in rising or setting, appear unusually large. Paul Stroobant points out (*Bull. acad. roy. belg.*) the absurdity of the vulgar explanation that intervening objects enable us better to estimate the real size of the heavenly bodies, in that the same effect is visible at sea, and indicates the fallacy of several other theories. He believes that there are two real causes of the phenomenon in question, both purely physiological, — one, the greater sensitiveness of the eye to angular magnitudes near the horizon; the other, a direct effect of the feebler light in the enlargement of the pupil, which, it would appear, tends to magnify objects, even when artificially produced. His theories are supported with numerous illustrations and experiments, the most interesting of which are to show that the distance between two luminous points within a room suffers the same apparent change as in the constellations, when, without altering the distance from the eye, the altitude is gradually increased; and the maximum augmentation is estimated in either case as about one part in four.

— It is stated in the Journal of the Iron and steel institute that an accident at a foundry in Melbourne, by which a red-hot iron casting was dropped into water, and was afterwards found to have become remarkably soft, originated a process for annealing chilled and other iron castings, which has just been patented in the United Kingdom. It consists in plunging the metal when it is reduced to a very dull-red heat, and just as the redness is about to disappear, into a mixture of treacle and water having a specific gravity of 1.005. The inventors do not confine themselves to this solution only; but it is found to give better results than any other that they have tried. The process is said to soften castings in such a degree that they can be punched, bored, and tapped as readily as wrought metal.

— W. T. Chamberlain of Norwich, Conn., has invented a cartridge in which the metal shell is filled with compressed air, and attached to the base of the projectile. A valve in the base of the shell permits the air to escape at will into the chamber of the gun, and the bullet is thus projected. He states, that, notwithstanding the imperfection of his apparatus, he has secured a range of half a mile with two hundred pounds' pressure.

— The *Academy* announces that the syndics of the University press (Cambridge, Eng.) have undertaken the publication of a 'History of the mathematical theories of elasticity,' left in manuscript by the late Dr. Todhunter. The work of editing and completing has been intrusted to Mr. Karl Pearson. The history will contain a complete bibliographic account, so far as possible, of all the writings on the subject of elasticity since the time of Galilei, including an analysis of the more important memoirs. The first portion is already passing through the press.

— By reference to the table given below, it will be seen that one of the most noticeable features of the observations made at the Russian polar station at Sagastyr, during the two seasons 1882–83 and 1883–84, was the relative steadiness of the temperature in comparison with other stations in high latitudes. Only in November, February, and March did the means for the two years differ by more than 2° C.

The first year the means diminished to February, and then rose. The second year the change was not so regular. This is in marked contrast to the extreme variations from month to month, experienced on the islands of the European polar sea and their vicinity (Jan Mayen, Bear Island, Spitzbergen, Novaia Zemlia, and Franz Josef Land), as well as in the North-American archipelago. In both seasons the number of auroras increased from September to a maximum in February, and then decreased rapidly.

Mean temperatures (Centigrade) and number of hours of auroras at the Russian polar station of Sagastyr, mouth of the Lena.

	Temperature.		Hours auroras.	
	1882–83.	1883–84.	1882–83.	1883–84.
September	0.1	0.6	13	23
October	—15.1	—14.1	87	69
November	—27.9	—25.7	179	83
December	—33.5	—33.3	191	178
January	—37.2	—35.8	194	151
February	—41.3	—34.0	197	126
March	—31.5	—35.2	137	118
April	—20.7	—21.8	10	8
May	— 8.1	— 9.7	–	–
June	0.9	— 0.2	–	–
July	5.1	–	–	–
August	3.8	–	–	–
Year	—17.1	–	–	–
General mean	. . . .	—16.7	–	–

— We learn from the *Athenaeum* that three new tidal observatories have recently been established in Indian seas, — one at Cochin, and two at Ceylon. There are now, in all, twelve such observatories in those seas, each continuing its work for a period of five years, as tidal observation has this advantage over land meteorology, — that, after a limited time, a particular locality is exhausted, and the instruments can be taken up and moved elsewhere. These observatories have recently absorbed a great deal of the attention of the Indian survey department; although their results bear only in a strictly scientific way upon the operations of the trigonometrical survey, and in helping to correct the charts and tables which are furnished to the practical navigator.

— The *Independent practitioner* for January contains an article by Dr. J. G. Van Marter of Rome, upon evidences of prehistoric dentistry in Italy. In the museum of Corneto-Tarquinius, a city on the Mediterranean coast, the author found two specimens of ancient dentistry, which the mayor of that city certifies were found upon the first opening of the buried Etruscan tombs. Professor Helbig further assures him that these were virgin tombs, which date back four or five hundred years before the Christian era. In one of the specimens the two superior central incisors are bound by a band of very soft gold to the teeth on either side. The artificial teeth are well carved, evidently from the tooth of some large animal. One other artificial tooth was held by the same band, but it is lost. Dr. Van Marter has in his own possession a skull in which the first upper molar on the right side is missing, and which shows plain marks of an alveolar abscess, proving conclusively the existence of toothache among the early Etruscans. As the tombs have been only slightly explored, and as only the noted men of Etruria were embalmed, the rest being cremated, it is not strange that these evidences of dentistry have been so long undiscovered.

— At a meeting of the Society Isis, Jan. 15, Professor Hempel, Dresden, Saxony, made a communication concerning his chemical analysis of the air, especially of the air collected daily by Prof. E. Hagen during his voyage from Liverpool to New York in 1883. The results may be summed up as follows: 1. The quantity of oxygen changes from day to day by one-half per cent; 2. The quantity of oxygen in the air seems to be larger the lower the barometer, and *vice versa*; 3. The air taken on the ocean, compared with the air taken by Professor Hempel the same day at Dresden, shows the same composition. The quantity of oxygen may vary on different days by one-half per cent; but the air from the ocean varied from the air of Dresden only by some hundredth parts of one per cent. Professor Hempel intends to continue his studies, and hopes to receive sets of tubes with air obtained from the meteorological stations nearest the north pole and the equator, and from one between, perhaps from Heligoland. He expects to find variations in the quantity of oxygen in these widely separated places, though they were not found in the specimens obtained in Dresden, and on the voyage from Liverpool to New York, because both are of about the same latitude, and influenced by the same currents of wind. Professor Hempel intends, therefore, next fall to go to New York, *via* Teneriffe, and to collect on the top of the peak, and at the bottom, air from the upper and lower trade winds.

— According to notes made by Mr. L. Belding at Zorillo and other places near La Paz, Lower California, in 1883, the Pericue Indians, the original inhabitants of that region, are now represented by a single individual, — an old woman of about seventy years, who was universally reputed to be a pure-blooded Indian, the last of her race. She was of good stature, robust frame, and dark complexion. The Indians south of 24° 30′ buried their dead in caves, or below shelving rocks, without regard to the points of the compass. The bones which were found were usually painted red. The skeleton of an adult male, found by Mr. Belding, was wrapped in cloth made from the bark of the palm, and bound with three-ply cord, plaited as sailors make sennit, the material being the fibre of the agave. The package, which was about twenty inches long, nearly all the bones having been disjointed, did not appear to have been disturbed since burial, although a femur and some of the small bones were missing. This skeleton was found in a small cave at Zorillo, the floor of which was covered about a foot deep with dry, coarse sand, formed from the disintegrating granite rock.

— This last season a small apple-tree on the shore of Todos Santos Bay, Lower California, blossomed and bore large, perfect fruit on its trunk, about an inch from the ground.

— A Mr. Lorenz of Baden has invented a new compound projectile for infantry rifles, which consists of a steel case with a core of lead. In the experiments made the projectile penetrated three millimetres of iron, twenty-seven centimetres of beech-wood, and forty centimetres of fir-wood; in all, 67.3 centimetres, placed at a distance of thirty paces from the muzzle of the rifle. The projectile was unchanged in shape, and the lead core remained firm.

— Dr. Everest, who crossed the Yukon Portage last summer, reports from Fort Reliance, Yukon River, his safe arrival there July 22, 1884. He found miners on the river seventy-five miles above Fort Selkirk, who reported very rich washings on a bar in the river, the gold-dust being very fine and scaly. He intended to ascend the White River last autumn, and, if possible, to cross to the Copper River this spring, and descend to its mouth. The country seemed to him to resemble northern Idaho, with rolling hills densely wooded with larch and poplar and willows along the river-banks, and luxuriant herbage.

— A course of public lectures has been commenced at San Diego, Cal., under the auspices of the Society of natural history, the proceeds to go toward a building-fund. The first was delivered by Mrs. Elizabeth Surr, lately of London; and the second by Dr. Frank Cowan, during the stay of the surveying steamer Carlile P. Patterson, on which Dr. Cowan was a guest during its voyage from the east, on the way to Alaska, where it is to be stationed.

— In a recent bulletin of the Geological society of France, Oehlert gives the result of an important study of certain imperfectly known types of Devonian brachiopods long since described by D'Orbigny, and which are fully illustrated. The memoir places on a sound basis the section of Rhynchonella named Uncinulus by Bayle, while Uncinulina of the same author is shown to be untenable. The paper is particularly important as a contribution to our knowledge of the Phynchonellidae.

— Dr. Theodore Stein has succeeded in obtaining photographs of the larynx. The throat and larynx are illuminated by an incandescent electrical lamp, cooled by Nitze's system of cooling by water. A small mirror reflects the image on a gelatine-bromide plate in a camera-obscura, and a photograph is obtained showing the organs in health or disease, thus removing all risks of laryngeal diseases by inhaling the breath.

— C. F. im Thurm, the German explorer of British Guiana, has undertaken a new expedition into the interior of this colony, in order to climb Mount Roraima. At a height of 5,600 feet above the sea-level he found a veritable garden of orchids; and, still more wonderful, on his way thither he found a tribe of Indians conducting a Christian service without a missionary among them.

— A cable despatch was received March 7, at the Harvard college observatory, from Dr. Krueger of Kiel, announcing the discovery of a new planet of the eleventh magnitude by Borelly on March 6d.3650 Greenwich mean time; right ascension, 11 h. 6 m. 13.5 s.; declination, + 7° 9′ 17″; daily motion, − 48 s. in right ascension, − 9′ in declination.

— The fourth course of free scientific lectures given by the Cincinnati society of natural history was concluded on March 6. The attendance, in spite of the weather, has been excellent. Among the lectures were 'Water-crystallization,' by Prof. William L. Dudley; 'Ancient vegetation of the earth,' by Prof. Jos. F. James; and 'Diatoms,' by Ex-Gov. Jacob D. Cox.

— The council of the Royal meteorological society was announced to hold at the Institution of civil engineers, on the evenings of March 18 and 19, an exhibition of sunshine-recorders and solar and terrestrial radiation instruments. The society will also exhibit any new meteorological apparatus invented or first constructed during the past year, as well as photographs and drawings possessing meteorological interest.

— Mr. Eugen Himly, in the *Photographic news*, Jan. 2, 1885, describes an apparatus to avoid the brilliant glare of an artificial light in photography. He conceals the light in a case from which the rays are thrown out by reflectors. This diffuser is mounted upon a rail on the ceiling, and can be slowly moved along this during the exposure, thus giving to all sides of the picture an equal brightness.

— At the meeting of the Gesellschaft für erdkunde in Berlin, Jan. 3, Dr. Steinmann read a paper on his journeys in southern Patagonia. In 1882 he went as geological assistant to the fourth German expedition to Punta Arenas, mainly with the object of studying the southern cordilleras. What struck him particularly here was the extraordinary difference in the plant forms to those of the southern cordilleras. While on the western slopes vegetation is rich in forms, the climate of the steppes reigns on the eastern side. From a geological point of view, the southern point of America is extremely simple in its build, but it is of a different character on the east and west. On the east, chalk formations occur almost entirely; while on the west, where there are innumerable islands, there is nothing but granite and crystalline rocks. Although the configuration of the coast has been studied thoroughly by the English, Dr. Steinmann thinks that many important questions have still to be settled; for instance, whether Laguna Blanca, lying to the north-east of the settlement Kyrsing Water, has an outlet to the west. Ultimately, the lecturer reached the laguna of the third settlement of Santa Cruz, of which it may with certainty be said that it was connected, until recently, with the Pacific Ocean. It may also be concluded that at that time the mainland was much more cut up by channels and waterways than it is now. In May, 1883, Dr. Steinmann visited, in the company of Fuegian seal-hunters, the islands south of the Straits of Magellan, including Tierra del Fuego. Ultimately, he made his way from the southern point of America to Bolivia, and here continued his investigations.

SCIENCE.

FRIDAY, MARCH 20, 1885.

COMMENT AND CRITICISM.

A THOROUGH and systematic scrutiny of the heavens for stars of large parallax, or stars comparatively near our solar system, has long been regarded a desideratum in astronomy. The bearings of such research on the laws of distribution of the stars throughout the universe of space are such that no substantial progress in the discovery of these laws can be made until the parallaxes, or what is the same thing the distances, of a large number of suitably chosen stars have become known. The determination of the parallax of a star necessitates the exercise of the utmost skill of the observer, and taxes to no small degree the judgment of the computer in reducing the observations; and only a few astronomers have been known to undertake the task. The parallaxes of two or three stars only have been determined by American astronomers, among whom Professor Hall of Washington is foremost, if not alone. He has also called attention in the *Analyst* to the facility with which the work may be conducted by a careful observer, and has developed the necessary formulas of reduction in such attractive shape that it is rather remarkable that so few of our observatories have engaged in the work. We commend it to good observers looking about for the opportunity of employing a moderate instrumental outfit to the best advantage.

When, however, we come to the determination of parallaxes in bulk, astronomers everywhere seem to have shrunk from the undertaking, each waiting for another to lead, until Dr. Ball, astronomer royal of Ireland, made a serious beginning of the task, about eight years ago, at the observatory of Trinity college, Dublin. While others have been content to measure and reduce the parallax of a single star occasionally, Dr. Ball is encouraged by the contemplation of a working-list of some nine hundred stars, and he has already completed and published his work upon nearly one-half of this number, — an unparalleled labor in this branch of astronomy.

We should mention here, also, the determinations of stellar distances made in the southern hemisphere by Dr. Gill and Dr. Elkin, the results of which indicate extraordinary precision of measurement. With renewed enthusiasm in this research, these astronomers have outlined a plan of operations which contemplates an extended parallactic survey of the stellar heavens, and which may be expected to be brought to a conclusion in eight or ten years. Dr. Elkin is already engaged in the preliminaries of the work with the fine heliometer belonging to the observatory of Yale college; and Dr. Gill has only lately placed with the Messrs. Repsold of Hamburg the contract for a new heliometer of seven inches aperture, — the largest ever constructed. In about two years from the present time he will begin at Capetown his part of the work of carrying out this conjoined programme of parallax research.

MANY HAVE remarked the gradual assimilation of scientific discoveries by the *οἱ πολλοι*. To us the process seems comparable to the percolation practised by the pharmacist. He takes good alcohol, and pours it on the drug of which he desires to extract the active principle. The spirit gradually soaks down through the substance, extracting its soluble portions, and issues from the lower end of the percolator, much changed in character. Usually, in the case of the druggist, the result is satisfactory; but, when scientific facts — the pure alcohol of science — are concerned, the additions received by percolation are almost invariably of such a nature that the percolate is useless. This is

strikingly exemplified in the case of a recent pamphlet containing 'a few facts about carpets;' but the result is the more interesting, since in this one example the analogies of the various stages of percolation are clearly seen. The writer starts with his pure *spiritus vini Gallici*, good in itself, but capable of being considerably changed by the maceration of improper substances. This alcohol is the fact, capable of scientific demonstration, that moths destroy carpets. Thus he runs on: "MOTHS. — Many are not aware that all the present damage is done when the millers commence to fly, as their very presence indicates the absence of the worm. It is to prevent the miller's incubating, that precautions should be taken." The alcohol with the next step begins to be discolored in the following manner, though to a slight extent: "A large proportion of the millers never hatch eggs, but die without causing any harm." We will let it soak awhile, and then this result is found: "The male miller, which does not fly, but runs very rapidly, is easily detected by his triangular-shaped figure; but, keeping himself out of sight, he is not so easily found."

Dropping our simile for the moment, we wish to call attention to a peculiar and reprehensible bit of wickedness of the 'males' in hiding from their lawful 'better halves;' for, so our author says, "his hiding explains the devious flights of the female in his search." Give ear now, good housewife, and recollect, that, besides protecting your carpets, you are avenging a great slight upon your sex — a slight which brings about a perpetual leap-year — by following out to its fullest extent the suggestion embraced in the following sentence, which, to return to our simile, renders our percolate still darker: "The killing of one male is equal to the extinction of many ordinary millers." Our alcohol is now almost saturated. Let us draw the stopper from the percolator, and allow the fluid to run out. It appears as follows: "The male miller is commonly known by the name of 'silver-fish.'" The process is complete; we have obtained our percolate; by degeneration our moth has evolved a thysanure. Our alcohol is spoiled: what shall we do with it?

A NEWSPAPER RUMOR from Washington, printed in the Boston *Advertiser* last Monday, to the effect, that, in consequence of a charge of extravagance in the conduct of the U. S. geological survey, Professor Shaler of Cambridge was 'talked of to succeed Major Powell,' brought out an immediate rejoinder from the former on the following day, defending the survey from a charge so injurious and so untrue. "It is my firm belief," says Mr. Shaler, "that no one of the scientific departments of the government has been so well and economically managed as the geological survey since it came under the able direction of Major Powell." The same conclusion will be reached by any one who gives the subject any proper attention, or who is acquainted with the character and methods of the able chief of this survey. A change made on such a charge, without honest and open investigation, would be iniquitous: after such investigation, there could be no doubt of the result.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Solar eclipse of March 16.

THE solar eclipse was very successfully observed here to-day, under good atmospheric conditions. Cumulus clouds were scattered here and there about the sky, but fortunately they did not obscure the sun at any critical moment.

The photographic apparatus was in perfect working-order, and about fifty pictures of the eclipse were secured, with the assistance of Mr. J. L. Lovell. All of these developed well; and the exposures were so distributed with reference to the times of the two contacts, and to the occultation of solar spots, that they may be expected to give good results for the relative positions of the centres of the sun and moon.

The last contact was also observed optically by Professor Esty, Mr. B. Rush Rhees, Mr. Thomas C. Esty, and myself, the results all agreeing within seven seconds. DAVID P. TODD.

Lawrence observatory, Amherst, Mass., March 16.

Hereditary abnormality of sense-organs.

Dr. Mason's note on 'Hereditary malformation' (*Science*, v. 1885, 189) reminds me of a case in which inherited abnormality of sensitiveness in sense-organs is of opposite signs.

The father (D. A. of Independence, Io.) has unusually acute hearing. The degree of acuteness cannot well be expressed in terms of normal audition: but it will suffice to say that he distinguishes voices, whispers, and other sounds at considerably beyond the ordinary range; that he frequently hears sounds inaudible to his companions; and that he perceives, discriminates, and comprehends faint sounds with great facility. His wife's audition was normal, and that of the progeny is variable. Expressing normal audition by N, and arbitrarily evaluating acuteness above and below this standard, the status of the family, including consorts (indicated by italics), is about as follows: —

FIRST GENERATION.	SECOND GENERATION.	THIRD GENERATION.
D. A. 65—N+2		
Mrs. L. S. A. (deceased) —N	*G. W.* 45—N Mrs. M. A. W. 42—N	(5 children, all —N)
	J. A. 40—N+1 *Mrs. M. D. A.* 38—N	(7 children, all —N)
	G. M. 42—N—1 Mrs. J. A. M. 37—N—3	Miss E. M. 11—N+1 J. M. 9—N Miss B. M. 7—N
	Miss M. A. 32—N+3	
	D. H. A. 30—N—3	
	T. A. 28—N—3	

The partially deaf members do not perceive the ordinary voice, but follow conversation readily if the voice be raised as high, say, as that of an out-door speaker.

It is noteworthy that none of the family were born deaf, but that sensitiveness of the auditory apparatus diminished during youth, either progressively or by stages coinciding with slight catarrhal attacks or other physiologic disturbances. The grandchildren born thus, scarcely reached the age at which deafness began to appear in the second generation.

W. J. McGEE.

Washington, D.C., March 11.

Preservation of jelly-fishes at the Naples zoölogical stations.

Zoölogists are to be congratulated upon the success which has at last attended the efforts of Signore Lo Bianco, the skilful conservator of the zoölogical station in Naples, towards the preservation of Siphonophorae. So extremely delicate are these complicated organisms as to have rendered futile all efforts hitherto made for their preservation; and students have been compelled to have recourse to drawings or models for the study of their structure in the absence of living specimens. The least carelessness on the part of the collector, results, as a rule, in the loss of many of the slightly attached parts; and if, perchance, the animals are brought in safety to the laboratory, they are available for study only during a very brief period. For over eight years Signore Lo Bianco has carried on experiments, attended with the greatest patience and skill and no small pecuniary outlay, only to meet with the fate which has ever attended attempts at their preservation, — to see them fall into a hundred pieces. Every working zoölogist can therefore readily imagine the satisfaction following the discovery of a method through which every museum may now place upon its shelves specimens of Mediterranean Siphonophorae retaining all the beauty and transparency of living specimens, — a privilege of which the directors of the various European museums are by no means slow in availing themselves, a large number of orders having already been received at the station for complete sets. Henceforth students of inland laboratories can study these interesting animals as satisfactorily as those at seaside laboratories, specimens being furnished, if desired, prepared especially for histological purposes. At no other place in the world has the art of preserving marine animals attained such perfection as in the Naples station, and at no other place is it possible. Owing to the large corps of skilled collectors, and to the rich fauna of the Gulf of Naples, material is constantly on hand for experimentation, and is manipulated by experts, who are instructed to spare no time or expense in the search for methods which shall retain the animals in their natural expanded conditions, and, if possible, with the brilliant colors of living specimens. A most interesting example is that of Corallium rubrum; the precious coral in which all the minute polyps are seen, with their tentacles fully expanded, furnishing a much more instructive object than the bits of dried twigs ordinarily to be seen in collections. Of the Siphonophorae, the most difficult of preservation were Forskalia contorta, Apolemia uvaria, Agalma Sarsii, Halistemma rubrum, Physophora hydrostatica, and Praya diphyes. These, besides many others, may now be obtained at prices which barely cover the cost of preparation, varying according to size, rarity, and process required, from one to thirty francs. The last two forms, owing to their habits, are not always on hand, appearing one day in hundreds, months elapsing before the collector again meets with them. American institutions have thus far been much behind those of Great Britain and the continent in taking advantage of the unparalleled facilities afforded by the Naples zoölogical station; Williams college and the University of Pennsylvania being the only ones which have taken tables and sent representatives, the latter being the only one represented at present. Several Americans have been able to occupy tables for short periods through the courtesy of German universities; but it would be much more creditable to America were her zoölogists able to meet with similar encouragement from home institutions.

C. S. DOLLEY.

Naples, Feb. 28.

Economy of fuel.

In your No. 103 of Jan. 23, 1885, under the heading 'Economy of fuel,' the coal-consumption of the steamship Oregon is stated at 16 tons per mile, which is equivalent to 48,000 tons for the Atlantic voyage! [Corrected, vol. v. p. 122.] I beg to request that you will publish, in correction of the above, the accompanying table, compiled from data furnished me through the courtesy of Mr. A. M. Underhill of the Guion line.

Name of steamer.	Tonnage.	Horse-power.	No. of boilers.	No. of furnaces.	Average speed of best trip from Sandy Hook to Queenstown, Ireland.	Fuel consumed per 24 hours, at 4½ tons per furnace.
					Knots.	Tons.
Arizona .	5,147	6,000	6	36	16.21	162
Alaska . .	6,932	11,000	9	54	17.44	243
Oregon . .	7,374	13,000	9	72	18.56	324

BAILEY WILLIS.

THE JOINT COMMISSION AND THE SIGNAL-SERVICE.

ONE of the last acts of the late congress was to continue in power the joint commission appointed "to consider the present organization of the signal-service, geological survey, coast and geodetic survey, and the hydrographic office of the navy department, with a view to secure greater efficiency and economy of the administration of the public service in said bureaus."

Thus far this commission seems to have elicited from the witnesses who have testified before it a considerable diversity of opinions, although each one is positive that his own service is properly conducted and needs no change. Major Powell and the committee of the National academy of sciences undoubtedly take a broad view of the questions at issue, and defend the abstract and theoretical importance of a union of all scientific work under one head, which may be either a person or a commission. The others generally defend special questions; such as, Is each organization efficient or economical? Does each co-operate with other departments? Is there an immediate need for any change?

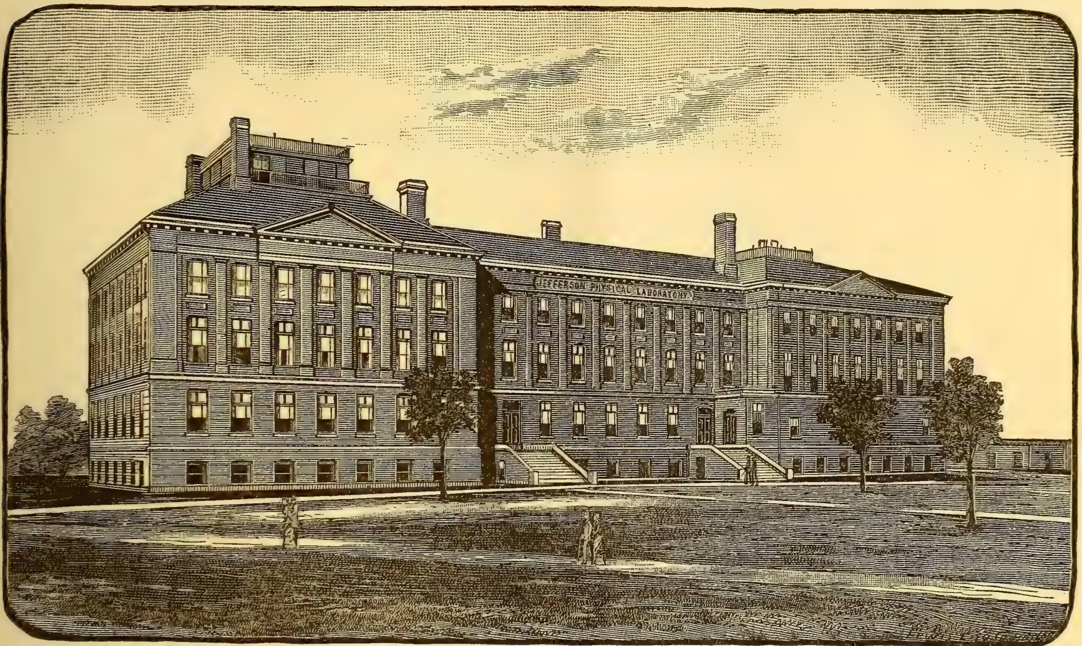
Many of the questions and replies imply that there are some underlying fundamental questions that should be discussed and settled before considering the matter of efficiency and economy. Some of these may be suggested, as follows: Shall pure science be separated from applied science? Shall the refined operations of the coast-survey, signal-office, etc., be classed as science, or as economic arts? Shall the civilian scientific element in the country be intrusted with applied sciences, or shall it only be employed to teach these to military and naval officers? Shall such officers be taken away from their proper work, thereby spoiling the little nucleus of an army and navy that the government maintains in times of peace? Shall the ten or twenty millions spent annually by government in internal improvement be disbursed by officers skilled in military engineering, or by civilian engineers especially fitted for the task? Shall all executive work be in the hands of various bureaus, including one of public works, while all scientific questions are referred to a special bureau of science whose members devote their whole time to the government service? Will education, science, and knowledge, and the progress of the people throughout the land, be stimulated more by giving scientific work to army officers, or by giving it mostly to civilians? Shall West Point, Annapolis, Willets Point, Fortress Monroe, Fort Myer, Fort Leavenworth, become not merely military, but also scientific, schools, with the understanding that the graduates of the civilian scientific schools at Cambridge, Ithaca, New York, New Haven, and elsewhere, cannot hope to receive much encouragement in the way of government employment? Shall our government make a decided effort to stimulate the general spread of education and scientific investigation by throwing its patronage into the hands of competitors from every rank of life? Shall not army, navy, and civilians at least stand on an equal footing in times of peace, and in questions of fitness to conduct works of applied science or higher engineering?

A slight examination will certainly show that very many of the public works carried on by the executive branch of our federal government have been assigned, whether by the president or by congress, in a very unsystematic manner, to the various departments and bureaus at Washington. Sometimes this has occurred, to the detriment of the work; but generally it has been to suit the exigencies of some temporary condition of affairs, and frequently for some political or personal reason. There is need, in fact, of considering the question of re-organization of all the government work.

However, the special and present business of the joint commission is to suggest, if possible, how to infuse a little harmony, efficiency, and economy into some or all of the public work; and most of the witnesses have confined their remarks to this restricted temporary aspect of affairs, leaving it to the commission, by cross-questioning, if possible, to draw more

profound truths from the partisan testimony of each witness.

The most expensive and important of the organizations studied by the commission is the signal-service; and considerable interest attached to the testimony of Professor Abbe, himself a member of the National academy of sciences, as it was hoped he would contribute facts favoring its transfer to a civilian scientific bureau. It is difficult to believe that he does not appreciate the strong arguments on this side of the question; but, like most government employees, he has chosen to consider the commission as an aggressive body, inquisitive as to whether the laws of congress have been properly carried out by his branch of the executive: he has therefore not touched upon questions of the general policy of the federal government, but has simply defended the present administration of the signal-office as being quite efficient and economical, and is especially strong in his defence of Gen. Hazen. He thus leaves it to his examiners to penetrate to the core of the matter, and to show that the proper interpretation of all and even of his own testimony affords an unanswerable argument against a purely military administration, and rather in favor of a purely civilian business and scientific one. The committee has evidently failed to obtain an exposition of the arguments for and against the present management of such institutions as the naval observatory, the signal-office, nautical almanac, geodetic survey, etc.

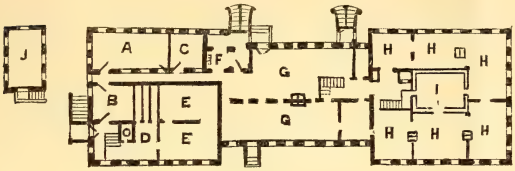


THE NEW PHYSICAL LABORATORY AT HARVARD COLLEGE.

THE JEFFERSON PHYSICAL LABORATORY.

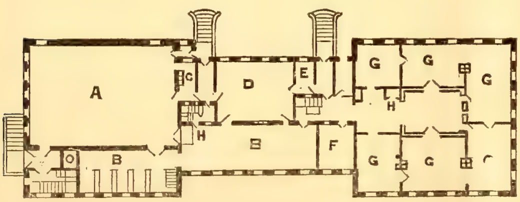
The Jefferson physical laboratory, which has recently been completed at Harvard university, is a three-story brick building with a basement, the floor of which is nearly on a level with the surface of the ground. The building is 209.4 feet long. The two wings are 67 feet square, and are connected by the main walls of the building, which are 46.8 feet apart. The ground-plan thus consists of two squares connected by a rectangle. The longest line of the laboratory runs very nearly east and west: there is therefore a great southern exposure, with no

trees or buildings near the laboratory to interfere with the employment of sunlight for optical purposes from dawn to twilight. The western wing contains no iron, all the gas-pipes and steam-pipes being made of brass. This wing has a separate entrance, and can be isolated from the eastern wing, which contains the large lecture-room and the elementary laboratory. The vibrations resulting from the movement of classes are thus obviated in the western portion. Each room in the basement and first floor of the western end is provided with brick piers, which are so arranged that instruments placed upon the south-west or the north-west corner piers can command long lines of sight east and west, and north and south. In the centre of the western wing, below the floor of the basement, is a constant-temperature room. This room is at the base of a tower, the walls of which are at least a foot from the main walls of the building. This tower rises to the roof, from which, however, it is entirely separate. In this way the effect of the wind is prevented from communicating vibrations to this inner tower. In the tower are placed large shelves of slate, which serve as piers on the second and third floors. The arrangement of rooms in the western wing is such that any room can be entered from the main hall without going through any other room. Moreover, two or more rooms can be thrown together if any experiment demands such an arrangement. There is gas and water in each room. Provision is also made for a line of sight entirely within the building nearly two hundred feet long.



BASEMENT.

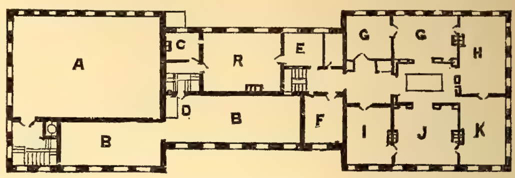
A, workshop; B, forge; C, battery-room; D, fire-room; E, coal; F, mercury-room; G, receiving-rooms; H, special investigation rooms; I, constant-temperature room; J, engine-room.



FIRST FLOOR.

A, space under lecture-room; B, first-story cabinets; C, preparation-room; D, recitation-room; E, professor's room; F, balance-room; G, special investigation rooms; H, elevators.

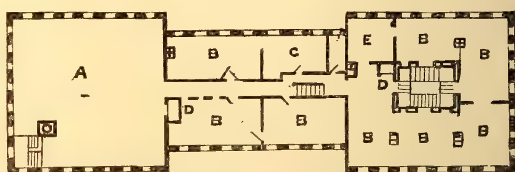
The portion between the two wings is devoted to recitation-rooms and cabinets. A lecture-room capable of seating an audience of three hundred is placed on the first floor of the eastern wing. Immediately over it is the large elementary laboratory sixty by sixty feet. Connected with the latter are several rooms for special investigations, which do not require the great steadiness of the western end. Immediately beneath the lecture-room is the workshop, together with a battery and a mercury-room. Power is conveyed to the workshop through a large tunnel which connects with an outside engine-house, in which is placed a twenty-five horse power engine and a seven horse power gas-engine, together with two dynamo-electric engines.



SECOND FLOOR.

A, lecture-room; B, second-story cabinets; C, professor's room; D, elevator; E, professor's room; F, library; G, optical rooms; H, Rumford lecture-room; I, sound; J, special investigation room; K, chemical laboratory; R, recitation-room.

The ground upon which the laboratory is placed consists of gravel, with a substratum of clay, which, however, is below the lowest foundation of the laboratory. The nearest street is more than three hundred feet distant, and it is found that no prejudicial vibrations are communicated to the piers. A vessel of mercury placed upon them, however, shows slight crispations and vibrations. The shelves placed in the isolated tower are steadier than the piers. This is probably due to the effect of the outside walls of the building in cutting off the surface vibrations, and suggests, that, if the future builders of physical laboratories desire ideal steadiness, they should sink walls outside



THIRD FLOOR.

A, elementary laboratory; B, special investigation rooms; C, library; D, elevators; E, photographic chamber.

the building, and build large masses of stone or brick upon which piers for delicate instruments could be placed. The conditions for steadiness, however, in the Jefferson physical laboratory, are fulfilled sufficiently for practical purposes.

The laboratory, together with its heating and lighting arrangements and engines, cost a hundred and fifteen thousand dollars. This sum was given by Mr. Thomas Jefferson Coolidge, on condition that seventy-five thousand dollars more should be raised for maintaining the laboratory. Many friends of the university contributed to this income fund.

The laboratory is named in honor of Thomas Jefferson, the ancestor of Mr. Coolidge. Jefferson, while president of the United States, evinced great interest in the promotion of university education in America, — an interest which took a practical form in the foundation of the University of Virginia; and the seed thus sown, it will be seen, bears fruit even unto this day. — JOHN TROWBRIDGE.

EVIDENCES OF BEACHES IN THE CINCINNATI GROUP.

THE presence of old beaches above present water-level is readily perceived on many modern lake and ocean margins, notably around Great Salt Lake and on the Peruvian and Chilian coasts of South America. The evidence of similar beaches in geological groups cannot be considered so decisive, nor is it so conspicuous.

That most of the strata of the Cincinnati group were deposited in deep water is probable. They contain many fossils whose modern relatives live in deep seas, and it is not likely that it was different with the ancient forms. Brachiopods, crustaceans, bryozoans, polyps, are all inhabitants of comparatively deep water, at least; and these forms are found in extraordinary abundance in the Cincinnati group.

Two apparently well-defined shore-lines have been noticed in the rocks in the vicinity of Cincinnati. One of these was first referred to by Dr. Locke some forty years ago. It crops out about three hundred feet above low-water mark, and is characterized by the dumb-bell fossil known as Arthraria. It is apparently to this horizon that Miller refers in the *Cincinnati quarterly journal of science*, i. 64, where he speaks of wave-lines in the rocks. He says, —

"These wave-like rocks are composed in a very large part of fragments of crinoids, principally of the Heterocrinus simplex, and appear to have been formed by the action of the waves in first breaking to pieces the animal skeletons, and then leaving them in ridges, as if to mark for all future time the course of the waves. These rocks are found in all the hills about Cincinnati, and as far east as Plainville [nine miles]. A number of fossils are found below these rocks that have thus far not been found above them; and, on the other hand, many have been found above that have not been found below. . . . The fossils which are common to both elevations comprise more than half of all those found below these rocks. And yet, on further examination, it may appear that the causes which led to the formation of these waves in the rocks, also caused a considerable change in the animals which inhabited the ocean at that time."

Here the probable existence of a shore-line is indicated. It seems to mark one of those periods of elevation which occurred during the deposition of the strata. The fact that many fossils are found above which are not common below, would indicate a serious disturbance of conditions, — a change which caused the extinction of many previously common species, and allowed the introduction of a few entirely new ones.

It is at about this horizon that rocks bearing marks of surface water-washings, and evident traces of the action of trickling water, are found. There are also indications in the rocks of the rippling of water, such as could occur only along the margin of a shallow sea. These marks have been described as Algae under various names, but their true character has been shown by comparing them with modern marks of a known origin.

A second ancient shore-line, as it appears to be, crops out at various points in the vicinity of Cincinnati. Probably the best exposure is at Ludlow, Ky., along the Ohio River, opposite the city. Professor Orton, in speaking of the waved structure of the rocks, refers to this locality as follows:[1] —

"The rocks exhibiting this structure at the point named [river-quarries] are the most compact beds of the fossiliferous limestone. The bottom of the waved layer is generally even, and beneath it is al-

ways found an even bed of shale. The upper surface is diversified, as its name suggests, with ridges and furrows. The interval between the ridges varies, but in many instances it is about four feet. The greatest thickness of the ridge is six or seven inches, while the stone is reduced to one or two inches at the bottom of the furrow, and sometimes it entirely disappears" (see figure).

[1] Geology of Ohio, vol. i. p. 377.

One of the explanations offered for this wave-structure is "that the floor of the Cincinnati sea was acted on from time to time by waves, or similar movements of the ocean-waters;" but it seems just as probable that these ridges were made by the action of waves on the shore. The stratum is made up of fragments of crinoid stems, brachiopods, and other forms of life. It is just as if it had been exposed to the action of the weather and the waves for such a long period of time that a fine sand was formed of crinoidal and shelly fragments. It is well known that the continual dashing of waves on a shore will soon reduce a mass of shells to powder. Dr. Leidy mentions[1] that while at Atlantic City, the beach, after every storm, is strewn with immense numbers of shells: in a short time these become reduced to fragments, and eventually disappear.

Every one who has collected shells on sea-beaches is aware of the difficulty of procuring perfect specimens after they have been exposed to atmospheric agencies for a short time. Still in some places, notably in the Bay of Fundy, tracks left on the mud, raindrop impressions, traces of leaves, and other marks, are preserved in a perfect state. At the same time it seems unlikely that organic matters will be preserved from decay. For this to be effected, it is necessary that they be covered almost immediately, and so deep that they are protected from the air or atmospheric changes. Both these conditions — the one necessary for the preservation of tracks on mud, and the other to entomb perfect organisms — seldom seem to occur at the same time and in the same place: consequently it rarely happens that in the stratum where surface-marks, burrows, and trails occur, *perfect* fossils of any sort are found. While the whole surface of immense slabs of rock may be covered with trails, burrows, or impressions of organisms, *no complete fossils are preserved.* In the stratum above or below they may and do occur. But, while no perfect specimens are found, fragments innumerable remain. Small pieces of crinoid stems, fragments of trilobites and brachiopods, jumbled together in inextricable confusion, are the only signs of fossil organisms. Sometimes they lie in heaps, as if thrown together by a swirl in the tide; sometimes there is only a fragment here and there, and even it shows unmistakable signs of the action of the weather.

Mud-cracks, too, evidence the fact that the surface was exposed to the action of the sun long enough to dry and crack the deposit. These cracks, filled up by a subsequent deposit of mud, remain to tell of their origin. These fossil mud-cracks are found in the same locality as the burrows, trails, and other surface-markings.

Professor Newberry, in the 'Geology of Ohio,'[1] says that the fact that the Cincinnati arch was upheaved before the deposition of the upper Silurian rocks is shown by the strata of the upper Silurian terminating in a feather-edge on each side of the arch, and by the Devonian being so reduced as to render it doubtful if it ever covered the top of the rocks of the Cincinnati group. Therefore it is probable that the Cincinnati arch, "during the upper Silurian, and through most if not all of the Devonian ages, . . . formed an island raised above the surface of the sea."

If this was so, a shore-line would mark the conjunction of the lower Silurian and the Clinton; and along this shore-line would be the place to expect to find such markings as would be made on an ocean-beach. In this regard, Professor Newberry says,[2] —

> "In Adams county the interesting discovery was made by Professor Orton, that a part of the Clinton is formed of a conglomerate of well-rounded limestone pebbles and worn fossils of the blue limestone [Cincinnati group] series."

And lately Mr. U. P. James has found a slab of rock near the top of the rocks of the Cincinnati group which shows well-marked and unmistakable impressions of raindrops, — marks which could not, by any possibility, have been made and preserved, except on an exposed surface.

It is well known that the Clinton group of New York is the one where most of the trails, burrows, and beach-markings have been found. Professor Hall says in regard to them,[3] that

> "They occur in greater or less number and perfection throughout the entire extent of the group;" and that (*Ibid.*, p. 26) "from the character of the surfaces of the arenaceous beds in which they occur, I am inclined to the belief that many of them were made while the bed was exposed above water, and most of the others in very shallow water. In many instances the marks of what appear to be *wave-lines* are still preserved upon the surface of the layers. These markings have been regarded as a line of beach at the period of the Medina sandstone; and the strata under consideration follow in immediate succession to that period. They are, moreover, associated with pebbly beds which were probably littoral."

Thus, if the markings and the fossil remains found in the Clinton are to be regarded as made on exposed surfaces, and if these same markings, or similar ones, are found in the rocks of

[1] Proc. Philad. acad., 1884, p. 12.

[1] Vol. i. pp. 94 *et seq.* [2] *Ibid.*, p. 103.
[3] Paleontology of New York, vol. ii. p. 27.

the Cincinnati group, the inference is just, that the markings from the latter had their origin under the same conditions. There is no reason for supposing that the Cincinnati Island was not subject to elevations and depressions alternately. The evidence here given, showing the presence of three former shore-lines, seems conclusive. Probably, were other localities and other groups examined in a similar manner, similar facts would be found.

JOSEPH F. JAMES.

HUDSON-BAY ESKIMO.

IN the report of the Hudson-Bay exploring expedition, it is stated that the only inhabitants of Hudson Strait and the northern part of the bay are the Eskimo, who have become quite familiar with the ways of civilization. The families are small, mothers having rarely more than two or three children, which, in consequence of the absence of farinaceous food, are suckled till three or four years of age. The number of Eskimo appears to be diminishing, as there are abundant traces of their former presence in force. About six miles south of Port Burwell are the remains of a large settlement, with subterranean dwellings, in a fair state of preservation, where remains of stone pots and implements are mixed with those of more modern date. At Port De Boucherville distinct remains of a very ancient Eskimo camp, in the form of heaps and circles of stones, are found on a raised beach at the head of what had been a cove when the sea-level was about thirty feet higher than at present. At another place in the same vicinity are more modern remains, consisting of rings of tent-stones, several rectangular walls a few feet high, and *caches* of a beehive form about six feet in height, such as are now used for storing meat, or as hiding-places from which to kill game. Around Port Laperrière, also, camping-places are found, which, from their elevation above the sea-beach, the decayed nature of the larger bones lying about, and the manner in which the circles of stones are embedded in moss and overgrown with lichens, must be from one hundred to three hundred years old. Still more ancient Eskimo works are discovered in the valley which comes down to the head of the harbor. These consist of a row of stones running athwart the brook at a contracted part of the valley, which would be suitable for the Eskimo method of trout-fishing if the sea were eighty feet higher than it is at present.

Along the Labrador coast the Eskimo gather in small settlements round the Moravian mission-stations; Nain, with a population of about two hundred, being the largest. Here they are educated, and the missions are self-supporting; the missionaries supplying the Eskimo, purchasing their catch and shipping it to London, and communicating with Newfoundland during the summer by a mail-steamer which makes occasional trips as far as Nain. Lieut. Gordon gives the Eskimo the highest character for honesty and docility.

PHYSICS IN THE SCHOOLS.

PROFESSOR WEAD has published the replies to a circular distributed by the commissioner of education, Mr. John Eaton, in regard to the best method of teaching physics in the secondary schools. The general impression obtained from these replies, which are from high-school teachers as well as from college professors, is that a certain amount of laboratory work in physics is desirable. Very few, however, of the teachers who have replied, can apparently speak from actual experience of the advantages of the laboratory method. Within a quarter of a century there has been a marked change in the views of those who have entered upon chairs of physics in our various colleges. The earlier professors of so-called natural philosophy looked at their subject from a semi-literary point of view, and did not descend into the laborious arena of the laboratory, where their half-brothers the chemists had long preceded them. To-day there are physicists who laugh at the old method of teaching physics; and, although we are somewhat conservative, we also are tempted to indulge in a sly laugh in our sleeve.

The problem of the best method of teaching physics in the secondary schools, however, can only be a faint reflection of the methods adopted in the universities. We are inclined to believe that it should aim to be a faint reflection, — popular lectures for stimulating the imagination of the boy, and rough experiments for the masses, in order to train the scientific instinct and the powers of observation.

The report contains valuable information in regard to the teaching of physics in England, Germany, and France. The general impression gained from this report is that the new methods of teaching physics have not been adopted in a large enough number of cases to warrant any conclusions from a study of those cases. The training of teachers is steadily improving, and every year our colleges and universities send out men imbued with modern methods of laboratory instruction. These men must have a marked influence on the future methods of teaching physics.

HALLUCINATIONS.[1]

WHEN a patient is hypnotized, he imagines that he sees all things as they are suggested to him, provided he is a healthy subject. But in these hallucinations a person who has lost the chromatic sensibility cannot be made to see suggested colors to which he is naturally blind. If the achromatopsy be limited to one side, the left for instance, and the hypnotized subject has the right eye closed, he obstinately affirms that he does not see the suggested color, and cannot be made to see it until the right eye is opened.

There is a second thing which shows, better than the preceding, that hallucination and sensation have the same cerebral origin: it is the property which hallucinatory images have of provoking the same

[1] Abstract of an article by BINET and FÉRÉ in the *Revue scientifique*.

effects of contrast as of sensation. Take a card, white on one side, and half green and half white on the other, with a dot in the centre of each side, to hold the attention. Look steadily at the green-and-white side for a minute, then turn the card, and the half corresponding to the green will have a red tint, and the other half will have a complementary green tint. The consecutive red image has developed, by induction, the green sensation in a part of the eye which had been impressed only by white. The same results are obtained if the subject be hypnotized. The experiment will fail if the subject is blind to the suggested color. If a subject is blind to a certain color, a peculiar case results. On giving him the hallucination of green, the sensation of red cannot be induced; but in giving the hallucination of red, which he can see, the induced sensation of green (to which he is blind) is produced.

The production of consecutive images is a normal phenomenon: so, in all hallucinations which last a certain time, a consecutive image follows. If one causes a patient in a hypnotized state to look at a square of white paper with a point in the centre, suggests that the square is red, and then suddenly presents a second similar square, the subject will say that the point is surrounded by a colored square, and the color will always be the complementary of the one suggested. This complementary color is the negative image left by the hallucination. It lasts only a short time, then becomes effaced. That similar phenomena are observed in the normal condition, may be proved by the following: if, with the eyes shut, we keep the image of a bright color in our mind a long time, then open them suddenly, looking upon a white surface, we will then see for a short time the image we were contemplating, but of a complementary color.

The following most curious experiment upon the mixture of imaginary colors helps to prove the same thing. Place two squares of differently colored paper at some distance upon a table; then place before the eye a plate of glass inclined in such a manner that the whole of one card can be seen directly, and at the same time a reflected image of the second. One can very readily cause the two papers to superpose, and become mixed. If we show a hypnotized patient the same thing, substituting blank cards, and suggesting colors for each card, they will appear mixed to him in the same manner. The necessary conclusion from this seems to be, that hallucination of a color is a suggested sensation, having the same cerebral seat as the real sensation.

THE OYSTER-FISHERY IN CONNECTICUT.

THE fourth annual report of the shell-fish commissioners of the state of Connecticut was recently issued, and contains, in concise form, much useful information. In its record of benefits accrued to the state by its system of ownership and moderate taxation of oyster-planting grounds, it offers great encouragement to those who would institute in each state systematic business methods in connection with this one of the most important of all our fishery interests. We have before referred to the system adopted by the commission in mapping and determining permanent bounds for the natural beds and ground available for planting. The survey of the natural beds, which are open to all oystermen under certain restrictions, has been completed. They comprise 5,805 acres. The total area of planting-grounds, designated for occupancy by the commission since its organization, is 45,046 acres, which have netted to the state $49,560. Adding to this the area previously designated by the seaside towns, and we have over 79,018 acres now under the control of individuals, of which 14,066 acres are under cultivation.

The total number of tax-paying cultivators in 1884 was 385, of whom 16 own each five acres or less, 53 between five and twenty acres each, and 332 own twenty acres or more each. The amount of tax levied, averaging ten cents per acre, was about $6,500, of which less than $50 are delinquent. This is trifling in comparison with the local taxation of grounds under town jurisdiction. Eleven hundred acres of grounds in the state of Rhode Island pay a tax or rent of a hundred dollars per acre to that state. The Connecticut commission has not valued grounds for taxation in excess of fifty dollars per acre, though lands have been reported sold during the year at from two to six times that amount. It is obvious, therefore, that the encouragement given by the state to those employed in this business is very great. The business is steadily growing. There are already over three hundred sailing-vessels and forty steamers employed, the latter with an aggregate capacity of 36,720 bushels; and several more steamers are being constructed. The first steamer was employed less than ten years ago.

There has been a very considerable increase in the sale of seed oysters and stock to neighboring states, and also in the exportation to Great Britain. Oysters for export are packed in barrels containing 950 four-year-olds, or 1,500 three-year-olds, the deep valve down and pressed very solid. One firm, exporting 10,000 barrels a year, has never lost a bushel by long passage, bad weather, or other causes. Many are shipped to California also. Accurate statistics are not available, as the oystermen seem to resent inquiries as an interference with their private business. In the course of time they will probably know their own interests better.

The chief injury sustained in the business is from star-fishes, which destroy the young oysters. It is estimated that over fifty thousand bushels of stars were destroyed last year. They are most destructive in the cooler weather. In July and August they form into great bunches or rolls for spawning, and lie quiet. In some localities there were few or none, in others such multitudes as had not been seen for many years. It has been suggested that the state should pay a small bounty for them; and, as they are worth something as a fertilizer, the sale would partly reimburse the outlay. The receipts of the commission were $13,731.84; the disbursements, $8,350.49.

SCARCITY OF LIVING ORGANISMS IN THE AIR AT HIGH ALTITUDES.

In the Geneva *Archives des sciences* for November, 1884, Mr. Freuderich has an article upon the number of living organisms in the air of the Swiss Alps. He shows that the experiments made by Pasteur in 1860 upon the same subject, and later by Tyndall, are unsatisfactory because of the small amount of air filtered, and because it seems, from the results, that the germs were not destroyed from the *bouillon* which was used in the experiment. Other observers have found astonishing quantities of germs in high altitudes, and in all these cases it seems very probable that the liquid was not thoroughly sterilized.

In Freuderich's experiments, by means of a portable steam-pump, air was pumped at the rate of a hundred and fifty litres an hour through a small glass tube with a capillary end. This tube was stopped with a wad of spun glass to retain any floating particles. Each wad was then placed entire in the *bouillon*. Later he still further modified this method by using the tube through which the air was pumped as a culture-tube.

Mr. Freuderich's most reliable experiments were made in the summers of 1883 and 1884. On the 12th of July, 1883, at the height of 3,200 metres, in 300 litres of air, no life was found. Again, on Aug. 5, at the height of 2,100 metres, he filtered 500 litres of air, and, on the next day, 400 litres on the summit of a neighboring mountain 3,970 metres high. The filterings from these two were sown in a broth of beef, but showed no signs of life. At Schilthorn (2,972 metres), Aug. 25, 1,500 litres of air were filtered and sown, but the fluid did not cease to be limpid.

In presence of the negative results of 1883, he determined not to confine himself in 1884 to the limit of eternal snow, but to choose some places more accessible to the germs of the air. On the Aletsch glacier, July 15 and 17, at a height of 2,900 metres, he pumped 2,000 litres of air through six wads. One of the wads, after a rest of fifteen days, gave birth to an organism of the family Tortulacea, and another contained a micrococcus, which may have been accidentally introduced. The second series was carried on above snow-level in Theodule pass (3,340 metres above sea-level) on the 6th and 7th of September. But in 3,000 litres of air he could find but one bacterium. The extreme poverty of the air at these heights is sufficiently proved by these figures. While these experiments were going on, the days were clear and the wind light, both circumstances favorable to the growth of microbes.

At Niesen (2,366 metres), July 25 and 26, rain and snow fell, and rendered the work very complicated, soaking the wads, and checking the work, so that not more than 600 litres were pumped through eight wads, all of which were sown at Berne, July 27. On July 29 the liquids sown with two of them were infested with a peculiar long bacillus, never met with except in the air of Berne; the next day another was infested with the same species; a fourth gave another bacillus; and Aug. 1 a mould appeared. Finally, about the first of September, a last conserve brought forth a mould after six weeks' incubation. The two others remained sterile; and hence we have a minimum of four microbes from 600 litres. We say minimum, because it is possible that more than one germ may have been caught on those filters which produced germs. In another trial, July 31 and Aug. 1, he filtered 1,725 litres through fifteen wads, in which he found four bacteria. In reducing the results, we find that we have in the air near Niesen between three and four bacteria in a cubic metre.

The richness of the air in this region is easily explained by the locality, the mountain being situated on the border of Lake Thun, and surrounded by a number of towns. Besides this, a small amount of vegetation is found on its summit. It seems that the purity of the air in these high altitudes is due less to the height than to the lack of a productive home for the growth of these organisms. From these experiments it seems perfectly proper to conclude that the mountain air is much purer than that of the lower regions, and even more so than has been supposed. Indeed, it is surpassed in purity only by that over the sea, which Commander Moreau has shown to contain only five or six microbes to ten cubic metres.

RECENT PROGRESS IN ENGINEERING.

Sir Frederick Bramwell, in his inaugural address as the recently inducted president of the British institution of civil engineers, called attention to the great progress made, during late years, in various departments of engineering. Taking up, first, the materials of construction, he noted the enormous gain in the economy of brick-making by the introduction of brick-making machines and the continuous kiln; the improvement taking place in the making of artificial stones now enabling them to be produced with uniformity of quality, and of such durability as to constitute them successful rivals of natural stones. The use of wood is steadily decreasing, partly in consequence of its scarcity, and of its unfitness for use where longitudinal stresses are to be encountered, and partly through the introduction of the other materials, which are now made at less cost than formerly. Progress is to be expected in the direction of improved processes for the preservation of timber. Asbestos paint, as used on the buildings of the proposed International inventions exhibition, has proved a safeguard in that case against fire.

The modern processes of steel manufacture are furnishing masses of enormous magnitude, and of great uniformity of quality. The processes of Siemens and of Bessemer are now supplying such steels; while the method of Thomas and Gilchrist is permitting the use of ores formerly quite inapplicable to such purposes. The cost of cast-iron is decreasing with the construction of larger furnaces, and the use of more highly heated blast, and with a better understanding of the chemistry of the process of

reduction. Copper is finding new and important applications in the new alloys, phosphor-bronze, manganese-bronze, and other compositions.

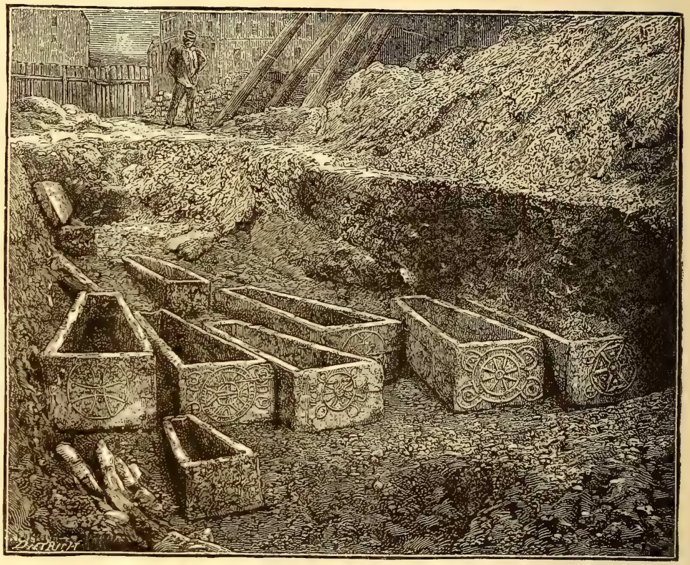
The working of heavy masses is demanding the construction of larger hammers; and it is becoming seen that light steam-hammers are actually injurious to the parts forged by them. Testing-machines are now in daily use, in the hands of the engineer, to determine the exact value of the metals proposed for use in his designs, and to exhibit the strength of completed members.

In bridge-construction, the St. Louis bridge was a novel departure in the use of steel in compression; and the New-York and Brooklyn bridge is an equally successful example of application of wires for suspension over long spans. The new bridge over the Forth exhibits still another modern novelty in its great cantilevers, the only known expedients for successfully spanning seventeen hundred feet with a rigid structure. In railroad and canal construction, the rivalry between the two systems of transportation is best illustrated by the enormous canals, now in progress and proposed, to connect ocean with ocean, and sea with sea, and, as in the case of the Manchester ship-canal, to take ocean-going ships into the interior of the country. This led to the study of harbor-construction, and reference to the methods of making and handling blocks of masonry weighing three hundred and fifty tons each, in the building of their sea-walls. A new and great improvement in the methods of supply of air for respiration, to the workmen sent into the depths during the operations just referred to, is that of absorption of exhaled carbonic acid by a basic salt, and the introduction of oxygen from under compression in small tanks carried by the diver, who is thus enabled to remain under water for considerable periods of time. In tunnelling in red sandstone, a speed of from ten to fourteen yards per day is attained, and of twenty-four yards in chalk. Dynamite and tunnelling machines are making this great progress possible.

Progress in motors has not been rapid during late years. The best of recent double-cylinder non-condensing steam-engines demand but two pounds and seven-tenths of coal per horse-power and per hour; while the condensing-engine has worked down to about a pound and a half. The gas-engine is gradually coming forward as a rival of the steam-engine in small powers; its greater safety, and the reduction of current expenses in various directions, giving it a superiority in some respects. Water-wheels have attained an efficiency of eighty-five per cent; and the turbine, with its high efficiency, offers great advantages in application where the fall is low, or the variation of height of tail-water considerable. In the transmission of power, the introduction of water, steam, and compressed air, sent out from a central station, is a promising direction of progress.

COFFINS OF THE SEVENTH CENTURY.[1]

WHILE digging a trench recently in the rue Salande in Paris, an ancient burial-ground was encountered. The discovery was made among the rubbish and ruined walls of the old Gallo-Roman outskirts at a depth of about one and one-half metres. Nineteen coffins made of plaster, and four or five of stone, were the most interesting things exhumed. The full extent of the burial-ground could not be determined, because it extends beneath some houses. That all



COFFINS OF THE SEVENTH CENTURY.

the sepultures belonged to Christians is probable from the fact that they invariably pointed toward the east, and by the Christian symbols. The coffins belonged to the seventh, eighth, and ninth centuries. Previous to this period they had been made of stone, but those of the epoch under consideration are mostly of plaster. The coffins all had the shape of an elongated trapezoid, being narrower at the foot, and were found filled with dirt, the covers having given way.

The plaster sarcophagi are not unique, since fully two thousand have already been reported as found. Figures are usually imprinted upon the exterior of the head and foot, but not more than one or two in a hundred are ornamented on the long side. The cross emblem of Christianity, inscribed in a circle symbolical of eternity, is the predominant form of ornamentation. There are numerous other ornamentations, but it is difficult to classify them, or to understand their signification.

[1] Abridged from *Science et nature.*

THE MOUNTAINEERS OF TONKIN.

FATHER PINABEL'S "Notes sur quelques peuplades sauvages dépendant du Tong King" is timely. He describes the mountaineers of the valleys of the Maa and Chou rivers, who are called Phou-Tays or Tays, but are commonly known to the Annamites as 'savages.' They reside in villages, are divided into tribes, each having a chief to whom great respect and obedience are accorded. Although, since 1834, Annamite mandarins have been appointed to each tribe, yet the Tays refer all disputes among themselves to their own chiefs, whose authority they recognize as superior to that of the mandarins. Medicine as an art is unknown: each family, however, has some recipe whose preparation is a jealously guarded secret.

The houses are made of bamboo, with roofs covered with palm-leaves; the whole raised upon piles to four feet above the ground. Below is the poultry-yard, where, if the owner is rich, pigs, oxen, and buffalo are kept with the fowl. The square fireplace is made of boards covered with earth. There is no chimney. Upon the hearth are three large stones, arranged as a tripod, on which, if nearly meal-time, rests a pot of boiling water, which supports a bamboo tube containing rice. This tube is pierced so as to permit the steam to pass through the rice, by which it is delicately cooked. The women stay about the cooking-fire, while the men resort to another fireplace at a lower level. If any one wishes to build a house, all the inhabitants of the village come to help, for no other remuneration than the customary feast when the house is finished. To celebrate this event, the head of the family kills a pig or a beef, and offers wine. The wine is made from rice and bran, and left to ferment for about a month in a jar hermetically sealed. When it is opened, water is added, and the guests seat themselves around it, and suck up the liquor through long reeds. The wine, which is sour but agreeable, contains so little alcohol that it is extremely rare to see a person stupidly drunk. After taking the wine, they gather in groups of four about little tables, and eat. This is followed by drinking tea and smoking.

Although amiable and conciliatory, these people are somewhat careless and apathetic, without solicitude for the morrow. Rising with the dawn, they smoke, fritter away some time in the house, start out fasting, and work until ten or twelve, when they return to dine. This repast over, they rest, take a *siesta* in summer, and in the afternoon return to the mountain fields for a few hours, or fish, hunt, or look for bamboos to make palisades about the fields lest the buffalo eat the newly planted rice. The evening is passed quietly in the corner of the hearth, and about eight o'clock supper is served. There are but two meals a day. The women's duties are more arduous than the men's, since, besides those within the house, it is theirs to pick, transport, and store the rice, and to fetch firewood from the mountains.

After death, they bathe the body, clothe it, and envelop it in a coverlid and a mat. Sugar-cane, rice, and salt are put into the mouth, — the sugar-cane to request the *manes* of the dead to be favorable, the salt to beg the deceased to preserve a good heart towards his parents. A rude coffin is made by felling a tree, cutting out of the trunk a piece of sufficient length, which is split and each half hollowed out. The day and hour of placing the body in the coffin are carefully chosen, for fear of evil consequences to the survivors if an unfortunate choice should be made. Before closing the coffin, the body is uncovered, the eyes opened that he may see the heavens, and then the coffin carefully closed. If the means are not at hand to defray the expense of burial, the coffin is preserved in the house, in some cases even for months.

On the day of the final ceremony, if the family is rich, a buffalo is killed, which is offered to the parents and inhabitants of the village, so that they may make charcoal. This charcoal is intended to put into the grave to preserve the coffin from dampness. Another buffalo is killed, so that the assistants may prepare a little hut to be placed over the tomb. A third buffalo is killed for those who inter the body. The site of the tomb is chosen in the forest, where it is forbidden to cut trees, or whatever may grow there, for fear the *manes* of the dead may avenge the outrage. At the end of the ceremony the parents seek the mountain stream. There a diviner has set up two reeds to form a pointed arch, beneath which each parent should pass. They are sprinkled with the water in which the rice was washed, and, after washing their garments, return to the house. At the foot of the ladder, before entering, they tear their hair. The bereaved eat rice from a sort of basket, and leave every thing in the house in disorder to witness to their grief. To the diviner, who reproaches them, they answer, "Our father is dead, and we no more know what to say or do." The diviner then restores the house to order, and sprinkles it with various herbs to chase away evil spirits, that in the future the house may enjoy peace and happiness.

THE WORK OF THE SIGNAL-OFFICE UNDER GENERAL HAZEN.

THE recent examination by the joint commission of General Hazen and other witnesses, as to the efficiency and economy of the present administration of the signal-office, is said to have brought out several statements as to the character of the work done by the weather-bureau, and the progress made by it during the last few years. The following is a brief summary of these, and especially of Professor Abbe's statement showing the status, and work being pursued, during the present fiscal year: —

The signal-service employs one chief, fourteen second lieutenants, and five hundred enlisted men, of whom one hundred and fifty are sergeants, thirty are corporals, and two hundred and twenty are privates, but all generally known as signal-service observers. These five hundred and fifteen persons constitute the signal-corps proper: but six officers detailed from the

line of the army are also temporarily attached to the service; and these have control of the disbursements, the property, the weather-predictions, the display of signals, the testing and comparison of instruments, the arctic stations, the international bulletin, the monthly weather-review, the Pacific coast section, and other main divisions of work.

These six officers, by the operation of the present laws, are being diminished in number by two annually, their places being filled by promotions from among the sergeants of the corps; so that in a few years the service will employ only officers and men of the signal-corps proper. This elimination of officers who have had from ten to twenty years' experience in the signal-service and the army is somewhat deprecated by General Hazen, who is very naturally loath to lose their services, while they themselves are loath to go; although it is evident that the corps proper already contains abundant and excellent material for the future needs of the service.

The signal-service also employs a number of civilians — namely, two chief clerks, several clerks of lower classes, and a scientific staff of three professors, four junior professors, and one bibliographer, and a large number of civilian observers, printers, messengers, artisans, etc. — at various points throughout the country. The number of civilian employees at the central or Washington office is sixty-four, all of whom give their whole time to the work. The total of those employed at other stations is apparently much greater than this; but each is employed only a short time daily, and most of them receive but twenty-five cents per day for some one special observation and record. The enlisted men of the service occupy about two hundred stations scattered throughout the United States, including Alaska, at an average distance of two hundred miles apart. About an equal number of stations are also occupied by civilians, observing the height of water in the rivers, or displaying storm-signals. From about forty-five hundred other civilian observers, reports are received gratuitously by mail on weekly or monthly forms. These observers are classified about as follows: voluntary land-observers, 270; voluntary marine-observers, 480; international observers, 330; Canadian observers, 18; state weather-service, 450; tornado-observers, 1,200; thunder-storm reporters, 2,000.

The following are some of the more prominent and important steps of progress taken during General Hazen's administration: —

The introduction of consulting specialists and civilian experts into the available working-force of the office; the assignment of selected sergeants and privates to work demanding a higher education and special aptness for investigation or study; the organized study of tornadoes, thunder-storms, atmospheric electricity, and other important novel fields of meteorological study; the introduction of weather-signals upon railroad-trains for the benefit of the farmers, and of local town-signals for the benefit of each community; the establishment of more severe rules for the verification of predictions, so that the eighty-five per cent claimed at present means much more than it did a few years ago; the enlistment of a higher grade of men; the improvement of the courses of instruction for men and officers; the compilation of a working-index to the literature of meteorology and the signal-office library; the organization of new divisions in the office, especially of the study-room, the physical laboratory, the marine division, and the examiner's division; the publication of a monthly summary of international simultaneous observation, with a weather-chart showing especially the storms on the Atlantic and Pacific oceans that affect the United States; the special study of atmospheric moisture with a view to improved methods of determining this factor; the special study of the exposure of thermometers, and correct methods for determining the temperature of the air; the maintenance of two polar and several auxiliary stations in pursuance of an international system for the study of the meteorology of the polar regions; the adoption of many of the recommendations of the European international meteorological congresses looking to uniformity of methods throughout the world; the adoption of improved methods of reducing barometric observations to sea-level; the stimulus given to the formation of state weather-services (this great advance has been wholly due to General Hazen, who has not hesitated to declare himself in favor of co-operation, and not monopoly; by his circulars and assistance, over fifteen states have been led to develop minute internal systems for the study of local climate and the dissemination of weather-predictions); the stimulus given to higher scientific work by members of the signal-service, by requiring and publishing professional papers, signal-notes, treatises, etc.; the addition to the signal-office of a few experts in scientific matters, who are responsible for the proper conduct of work requiring special study; the establishment of a high class of standard instruments, and more exact methods for testing-apparatus furnished to the stations, thus assuring against any deterioration in the accuracy of the work through many years to come; the encouragement and co-operation in scientific work, bearing on meteorology, by outside parties, such as spectroscopy, the study of solar heat and atmospheric absorption, and the prosecution of balloon-voyages; the adoption of a uniform standard of time for all observers; the adoption of a uniform standard of gravity for barometric reductions; the introduction of new special cautionary signals for high north-west winds and cold waves; the extension of signal-service stations in Alaska for the proper study of storms that strike the Pacific coast, and are followed by the severe cold waves from Manitoba.

In the prosecution of these and other multifarious labors, the signal-service certainly demands a high degree of organization, discipline, and intelligence; and it is by no means clear that this can be obtained in any better way than by a proper combination of military and civilian observers and scientific men.

THE TENTH VOLUME OF THE CENSUS REPORT.

The quarto volumes comprising the final report of the tenth census are not only more numerous and larger, and contain more detailed and perfect statistical exhibits of the population and products of the United States, than those of the ninth census, but they are also less purely statistical; the statistics being, in most cases, accompanied by elaborate discussions, which add much to the interest and usefulness of the figures. This statement is applicable to the whole of the tenth volume, but especially to the report on petroleum, by Professor Peckham. The statistics of the production, manufacture, and uses of petroleum, although set forth with all the fulness and detail desirable, are by no means the most prominent feature of this monograph of three hundred solid pages. The literature of petroleum, prior to 1860, was very scanty; but it has kept pace with the phenomenally rapid growth of this industry, being at the present time very voluminous and very fragmentary. Hence it was considered advisable to make this report an authority upon the subject by embodying the results of a careful examination of the entire literature of petroleum, supplemented by the results of the author's own researches before and during the census year. Fortunately, the work was placed in charge of a man well equipped by previous study and investigation; and the outcome is a monograph which the future student of petroleum will not ignore. And a feature not to be overlooked in this connection is the bibliography of petroleum, including more than eight hundred titles chronologically arranged, the earliest dating back to 450 B.C.

Although this work is, in its plan, a comprehensive treatise on the native bitumens of the globe, yet the author has not forgotten that it is in reality a part of the census report; and for this reason, and because of their preponderating importance, it is devoted mainly to the liquid bitumens of the eastern United States. It is conveniently divided into three parts, — the natural history, technology, and uses of petroleum. Part i. is the most important in point of size and general interest, including every thing relating to the mode of occurrence, distribution, origin, and production of petroleum. The geographical distribution of bitumens is illustrated by a series of maps, which show, among other important facts, that east of the Mississippi River the localities affording petroleum — in Canada, Michigan, Indiana, Kentucky, Tennessee, West Virginia, Pennsylvania, and New York — describe an ellipse upon the border of the Cincinnati anticlinal. This correlation of the distribution with the geological structure of the region introduces the very important chapter on the mode of occurrence of bitumens. It is shown here that the statement that bitumens are found in all formations, from the Cambrian to the tertiary, is misleading; since the really productive deposits occur chiefly at two horizons, — the tertiary in Europe, Asia, West Indies, South America, and California; and the Silurian and Devonian in eastern North America. For obvious reasons, the interest centres in the precise geological position of the petroleum in the last-named region; and Professor Peckham, after quoting the views of Hunt, Carll, and Andrews, concludes with the statement that each of these gentlemen is right in his own district; that the petroleum of Canada and West Virginia certainly does, and that of Pennsylvania does not, occur along anticlinal axes.

The scientific student of petroleum will turn eagerly to the chapter on the origin of bitumens, to find each theory explained by copious quotations, and the author's own conclusion, that while the asphalts and oils of California are of animal origin, and indigenous in the strata from which they are obtained, the petroleum of Pennsylvania and West Virginia is clearly of vegetable origin, and a distillate from formations below those in which it is found.

The practical side of the subject next claims attention in the sections on the development of oil territory; the drilling, pumping, blasting, flooding, and general management of wells; and the transportation and commerce of the crude petroleum, with the accompanying statistics. The unpoetical aspect of this industry is very vividly portrayed in the frontispiece and in the following paragraph: —

"The development of the oil territory proceeds without regard to any other interest. The derrick comes like an army of occupation. In the towns a dooryard or a garden alike surrenders its claims. The farms, fields, orchards, or gardens alike are lost to agriculture, and given to oil; and on the forest-covered hills the most beautiful and valuable timber is ruthlessly cut, and left to rot in huge heaps, wherever a road or a derrick demands room. Pipe-lines are run over the hills and through the valleys, through dooryards, along streets, across streets and railroads; and here and there the vast storage-tanks stand, a perpetual menace to every thing near them that will burn. Nothing that I ever beheld reminded

Production, technology, and uses of petroleum and its products, by S. F. Peckham. *The manufacture of coke*, by Joseph D. Weeks. *Building-stones of the United States, and statistics of the quarry industry for 1880.* Census report, vol. x. Washington, *Government*, 1884. 26+806 p., 119 pl. 4°.

me so forcibly of the dire destruction of war as the scenes I beheld in and around Bradford at the close of the census year; and nothing else but the necessities of an army commands such a complete sacrifice of every other interest, or leaves such a scene of ruin and desolation."

One important reason for the wonderfully rapid development of oil districts is thus forcibly presented: —

"The owner of oil territory must have it drilled, or it will be exhausted by his neighbors drilling a cordon of wells around his property. After it is drilled, the well must flow until the pressure of gas is exhausted; and after the oil has stopped flowing, if the owner does not pump, his neighbor's pumps will drain his territory; and if he 'pulls out,' the law compels him to fill his well with sand, and ruin it forever, to prevent the public injury resulting from letting surface-water into the oil-sand. There is, therefore, no other alternative presented to the unfortunate possessor of oil territory but to drill and produce, whatever the price of oil may be."

The encyclopedic character of this report is very clearly shown in the second and third parts, in which the statistics of the manufacture and uses of petroleum are preceded by historical and descriptive accounts, either original or compiled, of the apparatus, methods, products, and various applications in the arts; the sections on the use of petroleum for lubricating and illuminating purposes being especially full.

The report on coke is restricted to the coke made as a direct product, and used in blast-furnaces, and does not include that produced in the manufacture of gas. Nor are the coking coals taken into account, except incidentally. This is, like petroleum, essentially a new industry in the United States, the annual value of the coke produced having increased from $189,184 in 1860, to $5,359,489 in 1880; and this is the first time it has appeared prominently in a census report.

The statistics of production for the census year are very full, and are followed by a historical and descriptive account of the industry in the different states and in foreign countries. In the concluding sections, the preparation of the coal, and the various forms of coke-ovens, are described in detail. The statistics show that coke is probably, by weight, the cheapest of all manufactured products, selling for less than two dollars per ton; and that it may be considerably cheapened in the future by the utilization of the waste-products, which greatly exceed in value the coal from which the coke is made.

The census of the building-stones and quarry industry of the United States was planned and organized by the late Dr. George W. Hawes. His untimely death led to a much greater division of labor than is apparent in the preparation of the reports on petroleum and coke, the list of the more prominent contributors to this report comprising nearly a dozen names; and, what is more to be regretted, it also necessitated the curtailment of the strictly scientific portion of the work. The most noticeable feature of this report, from the scientific standpoint, is the absence of any evidence of a serious attempt to improve the really splendid opportunity which the thoroughly representative collection made by the agents of the census bureau presents to investigate the building-stones of this country. The census reports are far from uniform in this respect; some classes of products, such as the woods, cotton, wool, etc., being worked up much more thoroughly.

We do not find in this report any systematic statement of the composition, microscopic structure, texture, specific gravity, crushing strength, porosity, chemical behavior, etc., of our building-stones. In short, the report presents no data forming a basis of comparison by which, to take a practical view of the subject, we can determine the relative merits for particular uses of the products of the fifteen hundred and twenty-five important quarries operated in the United States during the census year. Almost the only distinctly scientific sections of the report are the chapter on the microscopic structure of building-stones, by Mr. Merrill, and that on the durability of building-stones in New-York City and vicinity, by Professor Julien. But the former is short, and on the text-book plan, with but few references to the stones of particular localities. The figures are few and unsatisfactory; the component minerals not being sufficiently distinguished by colors, or otherwise. And, although Professor Julien's essay is excellent so far as it goes, yet it is only a partial and local treatment of the subject.

The student of economic geology will, however, find chapters four to seven, which constitute the main part of the report, very valuable as reservoirs of field-observations, notwithstanding the general lack of experimental or laboratory data. These chapters are devoted to quarry methods, the statistics of production during the census year, descriptions of quarries and quarry regions, and stone-construction in cities. The thirty-two chromolithographic plates which conclude this volume are one of its most attractive features. They show the appearance of polished surfaces of our handsomest marbles, granites, etc.

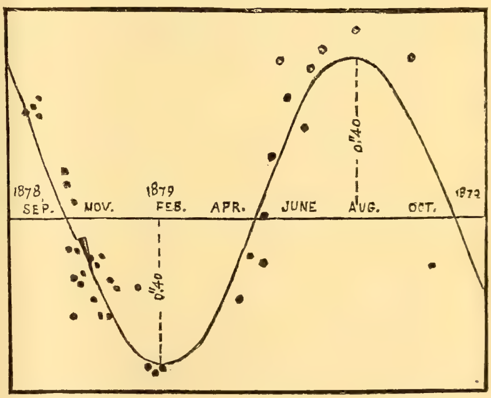
RESEARCHES IN STELLAR PARALLAX.

THE observatory of Trinity college, Dublin, has long been the most famous spot on earth for determinations of stellar parallax; and the labors of the present astronomer royal of Ireland, Dr. Ball, conducted in the same line of research, will make good the claim of this institution to such distinction for a long time to come. Before the time of Dr. Brünnow, formerly astronomer royal at Dunsink, no astronomers had, except in isolated instances, attacked the problem of stellar parallaxes for its own sake; that is to say, the determinations of parallax had come about rather incidentally, and had not been undertaken with the idea of determining stellar distances as the sole end of the research. The painstaking care which Dr. Brünnow exercised as an observer, and his conscientious thoroughness in the subsequent numerical work based on his observational data, were so skilfully combined as to show that the distances of the stars were readily determinable with a hopeful, and to a certain extent satisfactory, precision. The stars with which he was largely occupied were α Lyrae, Groombridge 1830, 85 Pegasi, and δ Draconis.

Dr. Ball, appointed astronomer royal some ten years ago, has wisely devoted the resources of the Trinity college observatory in the main to parallax research, and he has greatly amplified the plans of his predecessor. In the present volume he details the method by which his observations in systematic search for stars with a large parallax have been conducted; and it is plainly apparent how an enthusiastic worker can completely observe so many stars when special pre-arrangements are adopted for the economy of time and labor. With slight changes, these same methods would be equally applicable to the details of other observatory work, and would result in an equal saving: the methods are quite similar to those now so common in the details of library management, and have already been adopted by many astronomers in facilitating their work.

It will be a matter of interest to many to know how, from the myriads of stars in the sky, Dr. Ball was guided in the selection of a list embracing about a thousand objects. In the first place, only such objects were taken as were included between 30° and 65° of north declination, and every object of importance in Admiral Smyth's celebrated cycle of celestial objects was transcribed into the working-lists. Struve's catalogue was also drawn upon, and likewise catalogues of red stars by Schjellerup and Birmingham; the hypothesis with regard to objects of this type being that their color may be due to their small size, and thus presumably less far removed from the solar system. A number of the variable stars, also, are probably very small, and they were included in Dr. Ball's lists for a like reason.

It will not be understood that Dr. Ball's work amounts to a conclusive determination of the distances of all these objects: the objects of his research are at present very different from this; and his labors were directed with main reference to a decision, in all cases, whether the observed stars indicate a sufficiently large parallactic displacement to merit further immediate attention. Of course, there was no disappointment in finding that a very small proportion of the objects examined gave satisfactory evidence of a measurable parallax; but the labors of Dr. Ball are none the less important to future observers as indicating clearly the direction in which there is no pressing need of similar investigation. So much for the inconclusive part of this work. And we may now speak of the positive results in the shape of accurate determinations of the parallax of 61 (B) Cygni, Groombridge 1618, and 6 Cygni (B).



PARALLAX IN DECLINATION OF 61 (B) CYGNI.

The first star belongs to the famous binary system, the first determination of whose distance was made by the illustrious Bessel; and Dr. Ball finds its annual parallax to be very little short of half a second of arc. In order to show the degree of accuracy attained in

Astronomical observations and researches made at Dunsink. Fifth part. Observations in search of stars with an annual parallax. By ROBERT S. BALL, LL.D., F.R.S., astronomer royal.

Heliometer determinations of stellar parallax in the southern hemisphere. By DAVID GILL, LL.D., F.R.S., her Majesty's astronomer at the Cape of Good Hope, and W. L. ELKIN, Ph.D. Forming part i. of the forty-eighth volume of the memoirs of the Royal astronomical society.

such observations, we reproduce Dr. Ball's diagram representing his present series of observations on the assumption of his finally deduced parallax, 0″.4676. If this is the star's true parallax, it cannot affect the observed declinations to a greater extent than 0″.40, which is the maximum length of the ordinates in the curve. The large black dots indicate the observations, while the curve shows at every point the calculated effect of parallax. Of the discrepancies between the two, Dr. Ball remarks, that though some of them "seem large, relatively to the total amount to be measured, yet the greatest divergence of the observation from the curve is not more than the angle subtended by a penny-piece at the distance of fifteen or twenty miles."

Of Groombridge 1618, a star remarkable for its proper motion, we need only say that the parallax resulting from an elaborate series of observations is 0″.322 ± 0″.023; and, of the star (P iii. 242) suggested by Struve as suitable for a parallax series, that Dr. Ball finds its parallax inappreciable. Of the star 6 Cygni (B), however, more should be said, as comparison with 61 (B) Cygni shows both stars to be binary systems, with a large proper motion common to both, and color and magnitude substantially identical. Dr. Ball's investigations point to a parallax of 0″.482 ± 0′.054, so that to the other features of resemblance of the two systems we are to add the fact that the two objects appear to be equally distant from the solar system.

The parallax determinations of Dr. Gill and Dr. Elkin at the Cape of Good Hope are, without doubt, the most thorough and accurate work of the kind ever performed. The heliometer was not a large one, having an aperture of only four inches, and the interval of time set aside for the accomplishment of their programme was but eighteen months. It was considered essential that several of the parallaxes should be investigated independently by both observers, and with different comparison-stars, in order to obtain some test of the general accuracy of the conclusions reached; and, after much consideration and trial, the following stars were finally selected: α Centauri, Sirius, and ϵ Indi, for observation by both Gill and Elkin; Lacaille 9352, o_2 Eridani, and β Centauri, for observation by Gill alone; and ζ Tucanae, e Eridani, and Canopus, for observation by Elkin alone. In *Science*, vol. iii. p. 456, attention has already been called to the results of these investigations, and the remarkable degree of precision attained in the measurements. Every source of error of which it seems possible to conceive was most carefully considered, and terms for the elimination of such errors were suitably introduced into the equations of condition representing all the observations. The observers express their entire confidence, which must be shared by every one who critically examines their work, in the degree of exactitude which is indicated mathematically by their final results. All interested in the progress of stellar astronomy of precision will be glad to know that the important conclusions and suggestions in the memoir, with regard to future extended work in the same fields, are now to be put to the practical test by Dr. Gill and Dr. Elkin conjointly.

DAVID P. TODD.

NOTES AND NEWS.

AMONG the prizes awarded at the annual meeting of the French academy on the 23d of February were the following: the Francoeur prize, to Mr. Emile Barbier; a prize of six thousand francs, for the progress in efficiency of naval forces, was divided between the hydrographic mission to Tunis, and Mr. Baills for a work on artillery ('Traité de balistique rationelle'). Other prizes were given to Messrs. Manen and Hanusse (mechanics); to the Swiss engineer Riggenbach, the Monthyon prize, for his mountain railways; to Mr. Hoüel, the Poncelet prize, for his various contributions to pure mathematics; to Mr. du Rocher du Quengo, for his improvements in screw steam navigation; to Mr. Radau, the Lalande prize, for his memoir on diffractions; Mr. Ginzel, the Valz prize, for a paper on secular acceleration of the moon's motion; to Mr. G. Cabanellas, for his theory of the application of electricity to the transmission of power; Mr. Durand-Claye, for his researches on the diffusion of typhoid-fever; Mr. Chancel, for his work on the acetones; Messrs. Gustave Cotteau and Emile Rivière (geology); Messrs. Otto Lindberg, G. Sicard, L. Motelay, and Vendryès (botany); Mr. P. Fischer (zoölogy); Drs. Testut, Cadet de Gassicourt, and Leloir (medicine and surgery); Mr. Tourneux (embryology); Messrs. Cadiat and Kowalevski in anatomy; Messrs. Jolyet and Laffont in experimental physiology; Capt. H. Berthaut and Jules Girard in physical geography; Mr. Marsaut, 1,500 francs, for his investigations of safety-lamps for miners; Mr. de Tastes, for his work in meteorology; Mr. Valson, the Gegner prize, for his work in mathematics and physics; Dr. Neis, for geographical explorations; Dr. J. Boussingault, for applied chemistry. The Bréant prize of a hundred thousand francs for cholera researches was not awarded.

— The following account of unusual phenomena was received March 10, at the Hydrographic office, Washington, from the branch office in San Francisco. The bark Innerwich, Capt. Waters, has just arrived at Victoria from Yokohama. At midnight

of Feb. 24, in latitude 37° north, longitude 170° 15′ east, the captain was aroused by the mate, and went on deck to find the sky changing to a fiery red. All at once a large mass of fire appeared over the vessel, completely blinding the spectators; and, as it fell into the sea some fifty yards to leeward, it caused a hissing sound, which was heard above the blast, and made the vessel quiver from stem to stern. Hardly had this disappeared, when a lowering mass of white foam was seen rapidly approaching the vessel. The noise from the advancing volume of water is described as deafening. The bark was struck flat aback; but, before there was time to touch a brace, the sails had filled again, and the roaring white sea had passed ahead. To increase the horror of the situation, another 'vast sheet of flame' ran down the mizzen-mast, and 'poured in myriads of sparks' from the rigging. The strange redness of the sky remained for twenty minutes. The master, an old and experienced mariner, declares that the awfulness of the sight was beyond description, and considers that the ship had a narrow escape from destruction.

— A series of experiments has recently been conducted at Spezzia to ascertain the effect of torpedoes on a keel vessel of the type of the iron-clad Italia. Her steel plates were displaced and bent, and the water entered the compartments, but she maintained her position. The result is regarded as showing that the effect of torpedoes is overrated, and that they are insufficient for the defence of forts.

— The U. S. naval bureau of ordnance is experimenting with the megaphone in order to determine its usefulness in detecting the approach of hostile vessels and torpedo-boats while they are yet some distance off. It is thought, also, that by the aid of this instrument it may be possible to communicate between vessels by means of steam or other sound-signals at considerable distances.

— A cablegram received March 10, at the Harvard-college observatory, from Dr. Palisa, announces the probable discovery of Pogson's lost planet. Position, March $9^d.3533$, Greenwich mean time; right ascension, 6 h. 44 m. 41.7 s.; declination, 28° 10′ 1″. And a message from Dr. Krueger, received March 15, announced the discovery of an asteroid by Dr. Luther. Position, March 14 d. 10 h. 50 m. 52.8 s., Greenwich mean time; right ascension, 11 h. 48 m. 48 s.; declination, + 5° 13′; eleventh magnitude. No motion mentioned.

— The preparations for the Inventions exhibition at South Kensington are proceeding briskly. The literature of the exhibition will differ considerably from that of the two other exhibitions. No handbooks are to be prepared, but the papers which will appear in the catalogue will to a large extent supply their place. The catalogue will contain twenty-three prefaces written by authorities upon the particular subjects intrusted to them. Amongst those who have already consented to contribute are Sir Henry Nugent, on 'Fire-arms and explosives;' Sir E. G. Reed, on 'Naval architecture;' Capt. Douglas Galton, on 'Railway plant;' Capt. Abney, on 'Photography;' Professor Unwin, on 'Machinery;' Professor Armstrong, on 'Physical and chemical apparatus;' Professor Vernon Harcourt, on 'Gas;' Mr. G. Matthey, on 'Fuel;' Dr. Hugo Miller, on 'Paper and printing.' The first part of the catalogue is already in the hands of the printers.

— We learn from *Nature* that the Geological society of London has just awarded the Wollaston medal to Mr. George Busk, for his researches on fossil polyzoa and on pleistocene mammalia; the Murchison medal to Professor Ferdinand Roemer, the eminent paleontologist of Breslau; the Lyell medal to Prof. H. G. Seeley, for his long-continued work on fossil saurians; and the Bigsby medal to Mr. Renard of the Brussels museum, on account of his petrographical researches.

— *Liouville's journal* is in future to be published quarterly to avoid the fragmentary publication of important mathematical papers.

— The original lectures delivered by Harvey at the College of physicians are to be published in autotype from the manuscript in the British museum, accompanied by a transcript.

— The Cambridge (Eng.) university press has just decided to publish Mr. Charles N. Doughty's account of his extensive travels in the interior of Arabia, during which he discovered in the Harras beds of lava similar to those in the Zejah or Argob of the Hauran district, south of Damascus. The maps are already completed: so there will be little delay in the publication.

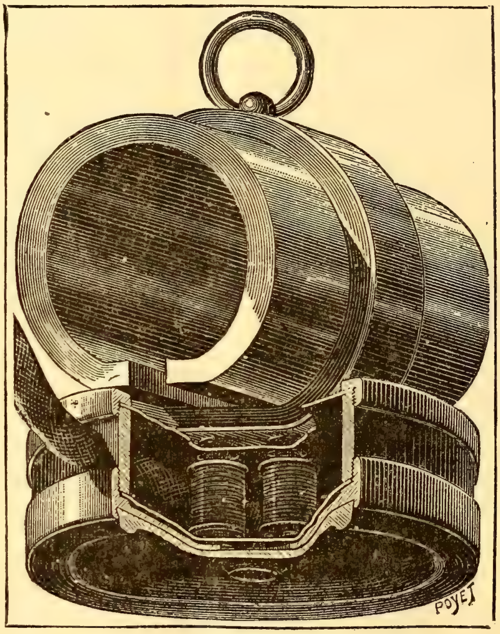
— The *Academy* announces the preparation, by Prof. O. Stolz of Innspruck, of 'Vorlesungen über allgemeine arithmetik,' intended to present in a form suitable to learners the results of modern researches on the science of number. The first part, now in press, contains an introduction on the conception of magnitude, treated in accordance with the views of Grassman; also chapters on the theory of irrational numbers, powers, roots, and logarithms, the theory of functions and of infinite series. The investigations of Hankel, Du Bois-Reymond, Cantor, Cauchy, Abel, Dirichlet, and other eminent mathematicians, have been carefully studied. The second part of the work will treat of the arithmetic of complex numbers, and some of its geometric applications.

— *Mind in nature*, a popular journal of psychical, medical, and scientific information, is announced to be published the first of every month, by the Cosmic publishing company, Chicago.

— The Journal of the Iron and steel institute notices some experiments recently made by Reinau (*Annales industrielles*) to determine the strength of iron as affected by different temperatures. It was found that the strength increased up to 554° F., at which temperature it attained a maximum, being thirty per cent stronger than at 68° F. Between 554° F. and 626° F., the decrease was very little, but the strength rapidly diminished after the last limit was passed. At 806° F. the bar broke under a load of only thirty per cent of the rupture load at 68° F.

—In *Revue de botanique* for October, 1884, Fonssagrives writes that fruits, even after being detached from the tree, give off both poisonous gases and carbonic-acid gas, thereby vitiating the air of a room so as to produce death by poisoning. Such accidents have been caused by ripe apricots, oranges, and quinces, which gave off the gas in the night. Had the air of the room been examined, there is little doubt that a sufficient quantity of oxygen to support life would have been found. Sweet-smelling flowers, such as jasmine, tuberose, and magnolia, and also odoriferous leaves, give off a similar deadly gas; and it seems that this gas must be in some way connected with the odor.

—*La Nature* publishes an account of a new loud-speaking telephone system recently presented by Mr. J. Ochorowicz to the International society of electricians and to the French society of physics. His transmitter is as yet a secret. The receiver, which is figured in the accompanying cut, is the same in principle with that of Bell. The magnet is formed of a hollow steel cylinder, with a slot on one side from five to six millimetres wide. To the centre of this cylinder are attached two little cores of soft iron, on which are rolled the bobbins. These bobbins are enclosed between two disks of thin sheet-iron. The lower plate, which is fixed firmly to the magnet, has two holes which freely allow the passage of the iron cores. The magnetism keeps the box in a state of tension. This receiver, with the peculiar transmitter of Mr. Ochorowicz, allowed speaking, singing, and music to be heard throughout the hall of the Paris geographical society,—a hall accommodating five hundred persons. In the microphone transmitter used by Mr. Ochorowicz, heat seems to play an important part, if one may judge from the fact that all the experiments made before the society of electricians on the 4th of February were successful except the last. Mr. Ochorowicz attributed this to the fact that the microphone needed to be hot: when it ceases to be so, the adjustment is destroyed, and can be re-established only by reheating. Leclanché cells were used, which became polarized, and allowed the transmitter to become cold.



OCHOROWICZ'S LOUD-SPEAKING TELEPHONE.

—A patent has been taken out in France by M. Tichenor for a process of butter-making by electricity. It is stated, that, the milk being placed in a vessel of special form, a pair of electrodes is introduced, and connected to a dynamo capable of yielding a current of forty volts, when in from three to five minutes the butter accumulates at one end of the poles in the form of little balls. The claims include the removal of rancidity from butter, and the manufacture of cheese, by the help of the current.

—We take the following account of the Fritts selenium cells from an advance copy of his paper, to appear in the Proceedings of the American association. "In the first place, I form the selenium in very thin plates, and polarize them, so that the opposite faces have different electrical states or properties. This I do by melting it upon a plate of metal with which it will form a chemical combination, sufficient, at least, to cause the selenium to adhere and make a good electrical connection with it. The other surface of the selenium is not so united or combined, but is left in a free state; and a conductor is subsequently applied over it by simple contact or pressure. During the process of melting and crystallizing, the selenium is compressed between the metal plate upon which it is melted, and another plate of steel or other substance with which it will not combine. . . . The non-adherent plate being removed after the cell has become cool, I then cover that surface with a *transparent conductor of electricity*, which may be a thin film of gold-leaf. Platinum, silver, or other suitable material may also be employed. The whole surface of the selenium is therefore covered with a good electrical conductor, yet is practically bare to the light, which passes through the conductor to the selenium underneath. My standard size of cell has about two by two and a half inches of surface, with a thickness of from $\frac{1}{1000}$ to $\frac{5}{1000}$ of an inch of selenium; but the cells can, of course, be made of any size or form. A great advantage of this arrangement consists in the fact that it enables me to apply the current and the light to the selenium in the same plane or general direction, instead of transversely to each other, as heretofore done."

—*Petermann's mittheilungen* has published a very detailed linguistic map of Hungary, with an article by Dr. T. v. Jekelfalussy of the statistical bureau, from which it appears, that, among every thousand inhabitants of the kingdom, there are 412 Magyars, 125 Germans, 154 Roumanians, 150 Croats and Serbs, and 119 Slovaks.

SCIENCE.

FRIDAY, MARCH 27, 1885.

COMMENT AND CRITICISM.

If our confidence in posterity be not misplaced, it will look with peculiar interest upon the hobby-horses of our day, particularly those used by some persons, with many external claims to consideration, in their raids upon physiologists and their work. One of these animals has recently been ridden in an attack upon a deceptive figure which was labelled with the name of Professor Martin of Johns Hopkins university. The arena as well as the figure, which, of course, was demolished, was furnished by the *Zoophilist*, falsely so called, — a journal supported by some antivivisection societies in England. But the real Professor Martin has come upon the scene with a little pamphlet, which is not only a 'correction,' but a severe 'castigation' and an 'appeal,' as its sub-title tells us.

During some nine years, Dr. Martin has been the esteemed head of the department of biology in Johns Hopkins university. Both by him, and by enthusiastic pupils working under his direction, many interesting researches have been undertaken, and some very important results have been obtained. One of the most valuable 'finds' is an admirable method for the study of the mammalian heart, isolated from all the influences of the body. This method involves the killing of the entire animal, except the heart and the lungs, which are needed for the artificial aeration of the blood. With the exception of the brief period required for administration of the narcotic or anaesthetic, the entire procedure is painless. The only possible exception is found in two instances where curare was used to exclude and control the action of the narcotics usually employed; and here the period of possible pain is very brief, lasting only until the blood-supply to the brain can be cut off. These experiments are not merely of the greatest theoretical interest, but their practical importance is immense and far-reaching. Already it has been possible to determine that fever temperatures of the blood are alone sufficient to act powerfully upon the heart, and alter its work. The hope which this form of study holds out, not only of increasing our understanding of the heart's action, but also of giving us much exacter knowledge of the action of drugs upon that organ, and the great value of such knowledge, must be evident to every candid person.

The Baltimore investigations have all been published in detail: no secret has been made of the method, and the work has had all the publicity which the ordinary channels open to such communications permit. The *Zoophilist* people met with one of the reports in the *Philosophical transactions* of the Royal society, and proceeded to give a garbled version, with comments, according to the method familiar to all who have read any of the peculiar writings of the antivivisectionists. This was well spiced with allusions to the barbarity permitted in 'far-off' America, and to the callousness of Dr. Martin, with 'his learned jargon and supposed results.' The reply will be found to be an honest and vigorous protest, which will have the hearty approval of every right-minded and clear-headed man. It not only gives a plain statement of the maliciousness and injustice and ignorance of his accusers, whose lies he numbers as he nails them, but it also contains a manly appeal to those among whom he has worked and taught, to stand by him, to protect him and others from this form of abusive misrepresentation; and he appeals, furthermore, to the officers and committee of the society, whose mouthpiece the *Zoophilist* is said to be. The list contains many names of those in good repute and in high places (there are not only ecclesiastical and courtly dignitaries among them, but, *mirabile dictu*, scientific worthies as

well); and Dr. Martin's plain declaration of the character of the work they support ought to call a blush of shame to the cheek of every one of them, unless, indeed, the disease may have already affected the vaso-motor centre.

The report of the commissioners of the Massachusetts state topographical survey for 1884 shows that the system of co-operative work with the U. S. geological survey has proved entirely successful. The work has been under the immediate control of the U. S. geological survey, but subject to the inspection of the state commissioners at every stage. Although the field-operation did not begin until midsummer, and was subject to all the difficulties of starting, an area of several hundred miles for detailed contoured maps was surveyed before the winter closed the field-work. The parties, few in number, were so placed that their work fairly represents all the varieties of topography within the state; and the results give a fair measure of the cost of a completed map on the scale of two inches to the mile, with contours at intervals of twenty feet. It appears that this cost is not likely to exceed fifteen dollars per square mile, and may be brought within twelve dollars.

The report recommends a further appropriation of three thousand dollars per annum, to be used in the determination by triangulation of the corners of the several town areas. The present system of delimiting the towns and preserving the memory of their bounds is an inheritance from former ages. It is said that in the old English days the memory of the boundaries was effectively maintained by taking all the boys of the town to the bounds, and soundly flogging them along the lines. By repeating this from year to year, the male population of the township was sure to have a lively, though perhaps unpleasant, sense of these limits. This simple method of fixing the boundaries has fallen into disuse, but as yet no more effective modern system has taken its place.

The commissioners of the Pennsylvania geological survey have stipulated with Major Powell to prosecute the survey of that state on terms similar to those arranged with Massachusetts. The plan requires an appropriation of ten thousand dollars per annum on the part of the state. If this plan is carried out, — and it is hardly conceivable that the Pennsylvania legislature will not do its part of the work, — the map of that state should be completed within ten years.

One of the greatest hinderances to the development of the United States arises from the imperfect knowledge of its surface and structure. Our modern life cleaves so closely to the earth, that at every step we need a vast amount of accurate information which our forefathers did not require. If the admirable plans of the present director of the geological survey are allowed to bear their point, by the end of this century, this hinderance may be removed; the whole surface of the national area will be mapped on a scale proportionate to the needs; and the cost of the work will not much, if at all, exceed that of maintaining a regiment of cavalry for the same time. There will be reason for sad comments on the American reputation for sagacity, if this work is not done.

Any one who has seen the results of the terrible upheaval at the south caused by the war is surprised when here and there he sees signs of returning prosperity. Knowing to how many a southerner, as he sits on his well-worn mahogany and gazes at his streaked mirror, it is the question of each day where he may obtain the meagre ration of hominy for himself he was wont to mete out to his slaves, it is actually a cause of wonder, when one hears now and then of the prosperity of some of the southern colleges, and at last of the revival of an interest in science, such as is shown by the formation of the Elisha Mitchell scientific society in North Carolina.

This society was the outgrowth of the small knot of studious men about the college at

Chapel Hill, and completed its first year of existence last autumn. In its first report it is stated to have seven life-members, seventy-five regular members, and seventy-four associates. Monthly meetings have been held in which the interest taken was encouraging. The papers published in the first numbers of the yearly report of the society are of good character, and receive much of their inspiration from the chemical laboratory of the University of North Carolina. A biographical sketch and portrait of Mitchell are prefixed.

LETTERS TO THE EDITOR.

Mr. Melville's plan of reaching the north pole.

IN the issue of the New-York *Evening post*, Feb. 6, I opposed Mr. Melville's plan of reaching the north pole,[1] as I could not consider the theory on which it is founded correct. In answer to my remarks, Mr. Melville in the same paper, Feb. 17, maintains his position, and denounces his critics for hindering his endeavors, instead of "sending him to prove his theories he has so much faith in, and permitting him to bring back the necessary facts that alone can carry conviction to the unbeliever without a theory." He says, "It would be more in the spirit of progress and the advancement of science, if my critics would propound new theories or other plans of progress, rather than simply find fault or say, '*I don't believe.*'" We cannot coincide with this opinion of Mr. Melville, and claim the full right to criticise a plan of exploration before it is set in motion. What is the cause of so many failures of arctic expeditions and other undertakings? Is it the careless neglect of thorough deliberation before entering into expeditions, or is it the hostility of nature? Have we nothing to learn by the Jeannette and the Proteus? If we should claim at any time the right of criticism, we do it now, when the blunders and misfortunes which effected the failures of the last expeditions are deeply impressed on public minds, and nearly extinguish the little interest which is left for scientific work in the Arctic. We consider it in the spirit of progress of science, to prove the fallacy of a plan founded on theories like those of Mr. Melville, which cannot be accepted by scientific men, and must lead to disaster, or will at least be unsuccessful.

It is somewhat difficult to understand Mr. Melville's theory; and I do not know that I am able to give an explanation of it which will satisfy the author. Mr. Melville supposes that the Arctic Ocean, north of 85° north latitude, is covered by a solid ice-cap kept in a state of equilibrium by the centrifugal force. He intends to start from the northern limit of Franz Josef Land on sledges, travelling over the smooth ice-cap towards the north pole, — a supposed distance of five degrees; i.e., three hundred miles out and three hundred miles back. In returning he intends to use the southern drift of the ice, which will carry him either back to Franz Josef Land or to Spitzbergen, where he would have depots erected for the use of the retiring party.

[1] G. W. Melville, In the Lena delta. Boston, 1885.

His view about the ice-cap will be seen from the following quotations (*l. c.*, p. 475): "After crossing the eighty-fifth degree of latitude, the traveller will come to that immovable ice-cap which will in all probability prove to be a palaeocrystic sea of ice and snow. We should have a clear, unbroken surface to travel upon, subject, of course, to fissures and shrinkage cracks." P. 476, he says, "The countless million square miles of ice annually expelled from the Arctic Ocean alone prove the fallacy of a 'palaeocrystic sea of ice;'" p. 478, "Let the state of the ice be as it may, it certainly can be no worse than the broken path over which the Jeannette's crew marched."

From these quotations, it would appear that Mr. Melville is not very certain of the existence of the ice-cap. The assertion, however (p. 479), that "the feat of marching to the pole and back will be easily practicable," and the fact that his plan is founded on this theory, prove Mr. Melville's confidence in it. If it can be proved that Mr. Melville's reasons for the existence of an ice-cap cannot be maintained, if it can be proved that an ice-cap cannot exist, his plan must needs fall to pieces. Let us enter into his proofs singly.

First: "As the centrifugal influence is acting equally in all directions, and tending to pull the ice-cap towards the equator, it can only carry away those detailed portions of ice broken near the outskirts of the ice-cap" (p. 474). No doubt, the centrifugal pull at a certain parallel will be equal on every meridian; but, supposing this continuous ice-cap to exist, an equal pull could only come to pass if it extended to the same parallel all around the pole. Every mile added to one side would increase the pull there, and disturb the equilibrium which Mr. Melville requires for his theory. Besides, we cannot imagine any kind of ice strong enough to stand the immense tension effected by the centrifugal force on a solid body of three hundred miles in radius. An approximate computation of the effects of the centrifugal force on a body of ice of three metres' thickness, extending from latitude 85° to 86°, gives a tension of nearly thirty kilograms on one square centimetre.

As soon as Mr. Melville will grant us the slightest motion of his ice-cap in any direction, he has to give up his theory, as the "nucleus of pointed island peaks, which, if nothing more, will hold the ice fast at the pole" (p. 474), will not any longer hold the cap, but break it up into an immense pack. I suppose Mr. Melville will concede that his arguments referring to an equal pull by the centrifugal force cannot be maintained.

The hydrographical and meteorological theories which he brings forth in favor of his plan cannot be supported from the present state of our knowledge in these sciences.

He supposes that there are two currents, — an equatorial, setting north; a polar, setting south, — and between both a neutral zone which he supposes at about 85° north latitude, where scarcely any current exists. Considering the observations on currents in the polar seas, we cannot understand how Mr. Melville can propound such a theory. This is not the place to treat of modern oceanography; and I can only refer to Thomson's and Carpenter's works, and to Zöppritz's mathematical theory of currents, which give a basis to this science not allowing us to form theories like Mr. Melville's. We may only be permitted to say a few words about the improbability of symmetrical currents such as Mr. Melville supposes. The Arctic Ocean forms a large Mediterranean Sea, with one wide outlet between Greenland and Norway. The exchange of water between the Arctic and the

Equatorial Ocean must be affected through this strait, as the narrow and shallow Bering Strait cannot have any influence on this system of currents. No warm current forms there a 'thermometrical gateway' to the pole. The surplus of water annually added to the arctic sea must take its way through the strait between America and Europe. In its eastern portion, between Iceland and Norway, the warm current reaches to the comparatively shallow bottom of the sea (see Mohn's researches in *Petermann's mittheilungen*). North of the submarine elevation connecting Iceland and Norway, which nowhere exceeds four hundred fathoms in depth, the cold water of the arctic sea is dammed up: so the northern current has to pass the narrow Denmark Strait between Iceland and Greenland. Here we observe the immense ice-laden current following the coast of East Greenland. Through this strait the deep-sea motion towards the equator must take its way, as not a drop of cold water passes east of Iceland. The cold water rising at the equator can pass only this way. But, from the present state of our knowledge, we do not yet know whether the greater part is carried along by the deep-sea motion, or by the superficial current. The fact is, that the polar ocean is an immense Mediterranean Sea, with one outlet, through which the surplus of water has to find its exit: therefore the whole area near the outlet must be moved by strong currents; while the remote parts, the sea between the Parry archipelago and North Siberia, will only be affected by the prevailing winds. If there were no other reason, this would be sufficient to prove the impossibility of symmetrical currents around the poles.

As for Mr. Melville's meteorology, I confess that I cannot undertake to refute his theory at this place, as I should have to fall back on the elements of this science and those of physics. "And as they [the air-currents] *do* follow the earth's surface, they take their direction toward the pole, following the spherical surface of the earth until they reach the shoulders of the ellipsoid, where the flattening of the earth commences (!); then, having received their course and direction for a distance of nearly five thousand miles, they follow their *projected direction*, and continue on above the earth's surface just as much as the flattening of the earth at the poles amounts to." (!) I should be glad to learn the place where the earth begins to flatten! Mr. Melville's assertion that a low atmospheric pressure exists in high latitudes is not correct. The centres of low pressure are the Bering Sea and the North Atlantic Ocean around Iceland. Besides, regions of a low barometer are not those of calms, but of winds.

In short, Mr. Melville's theory cannot uphold itself, and a plan founded upon it cannot prove successful. We wish Mr. Melville might confine himself to the principle that every plan of advance towards the pole should be made according to former experiences, not vague theories. We hope he will succeed in reaching Franz Josef Land, and there, no doubt, he will find most interesting results; but we oppose the hazardous undertaking of leaving the land in order to reach the pole. From the experience he will gain in the far north, he may propound a new plan founded upon his own observations there.

We think the enthusiasm of Mr. Melville for arctic researches is highly to be praised. If any thing can encourage the public, it is the struggle of the arctic heroes for their noble task, the perseverance with which they brave the dangers of climate and ice, as well as the narrow-minded opponents who scorn their ideals. We hope Mr. Melville does not class us among these. We have the most hearty interest in polar exploration, and only wish Mr. Melville might save his life and his experience for an expedition not so hazardous and not so adventurous as the proposed one.

Dr. Franz Boas.

Did Cortez visit Palenque?

This interesting question, propounded by Professor Cyrus Thomas in *Science*, v. p. 172, should attract the attention of archeologists.

As there are some inaccuracies in his statements, and as, from a study of the documents in the case, I reach different conclusions, I beg to submit them to your readers.

The locality 'Titacat' was not reached *after* the execution of Cuauhtemoctsin (as Professor Thomas says), but was the station next previous to the one at which that event occurred; to wit, at Izancanac, the capital city of the province of Acalan.

As to this name 'Izancanac,' it is evidently in the Maya language, and means 'the residence of the chief of the Itzas,' who were a well-known Maya tribe. The province of Acalan is placed, on old maps, on the southern and eastern shores of the Bahia de Terminos; and, according to Cortez, its chief city was on or near the shores of this bay.

When at Zagoatespan, between which and Izancanac the only stations were Teutiaca and Tizatepelt, Cortez sent a messenger by sea to Acalan: hence both these places were on the seacoast, or near it. At Zagoatespan he was informed that there were two roads to Acalan, — one up the country; the other, shorter, near the seashore. He followed the latter, having to pass through extensive marshes, and to cross an arm of the sea (Estero, ô Ancon) over five hundred yards wide, and from four to six fathoms in depth. A day and a half's journey from this was Tizatepelt, the first town in the province of Acalan; and five leagues from it was Teutiaca, from which Izancanac was less than a day's journey.

This plain statement shows, beyond all question, that Cortez' route lay nowhere near Palenque, and that those who place it there cannot have traced it out according to his own notes in his celebrated 'fifth letter.' It was close to the seacoast, and quite far from those celebrated ruins.

As for his description of the temples of Teutiaca, he represents Izancanac as a much larger city, with more temples, and altogether a greater place (*muy grande y de muchas mezquitus*).

D. G. Brinton, M.D.

Mammalia in interglacial deposits.

May I be permitted to ask aid from some American contributor to *Science* who follows the lore of glacial geology? I learn that some American glacialists are satisfied that there have been two periods of glaciation, and I would inquire whether the interglacial deposits contain, like those of Switzerland, remains of mammalia, and, if so, what they are. Any reference to American evidence on these points would oblige

W. S. Symonds.

The Camp, Sunningdale, Eng., Feb 27.

Colored stars.

The planet Jupiter and the star Regulus (α Leonis) just now are so situated as to give us a fine example of a naked-eye colored double star, and strikingly illustrate the optical effect produced by two neighboring stars of very different magnitudes. The component colors, as they appear to the writer this even-

ing (March 11), are, Jupiter, yellow; Regulus, blue. The naked-eye view is very similar to the double star β Cygni, when seen with a power of about one hundred. Struve calls the color of Regulus bluish white; but its color now appears decidedly blue, or greenish blue. S.

Acquisition in infants.

I recently tried teaching Constance A., twelve months old, to ring a common dome table-bell. Perceiving the little knob on top to be somehow concerned, she fingered it clumsily, but could not learn to strike down on it accurately with her raised hand, though I forced her to do so many times. She made clumsy motions, but finally, half accidentally, she rang it. This was enough. She at once rang it repeatedly with great success. I took it away to test her memory, and the next morning she rang it immediately without suggestion, but had it for a moment only. She was then absent four days: on returning, she rang it at once. C.

Devonian strata in Montana.

The following note is written simply to place upon record the first positive identification of Devonian strata in the Rocky-Mountain region of Montana.

In 1872 the Hayden survey brought in, from several localities in the territory, collections of fossils, consisting mainly of separate valves of brachiopods embedded in a hard limestone. They were examined by Prof. F. B. Meek, who found that the species were mostly new, and that the genera represented were, without exception, common to both the carboniferous and Devonian, while a small proportion was also represented in the Silurian. In Hayden's sixth annual report, p. 432, Professor Meek says, "Some of the Producti, Chonetes, and Spirifer have rather a Devonian look, while a very finely striated Hemipronites is very similar to some of the Devonian types of that genus. Even the form I have referred to, H. crenistria, is quite as nearly like some varieties of H. chemungensis (Streptorhynchus chemungensis, of the fourth volume, Paleont. New York), from the Chemung and Hamilton groups of the New-York Devonian, as it is like the carboniferous forms of H. crenistria." However, notwithstanding the resemblance of the fossils to Devonian forms, he regarded the whole collection as belonging to the lower part of the carboniferous, as it contained no strictly Devonian types of corals, crinoids, or lamellibranchs. He at the same time stated his belief that they were referable to a lower horizon than the other carboniferous collections brought in from adjacent portions of Montana at the same time. The specimens examined by Professor Meek were mainly from the mountains on the south, east, and north sides of the Gallatin valley. During the summer of 1884, the writer, in company with Dr. F. V. Hayden, had occasion to revisit a portion of this area. In a section made at a point four or five miles north-west of Hamilton, running north-westwardly from the Gallatin River, a collection of fossils was obtained from beds which at the time were supposed to be of lower carboniferous age, and which were colored carboniferous on the geological map made in 1872. Upon returning from the field, the specimens were submitted to Mr. Charles D. Walcott of the geological survey, who identified them as undoubtedly Devonian. The following lists were prepared by him. List No. 2 includes some specimens obtained from a locality three or four miles north-east of the point from that where those in the first list were found.

Devonian fossils from north-east of Gallatin River, Montana.

LIST NO. 1. — Discina lodensis Hall (?); Streptorhynchus chemungensis Conrad; Orthis Vanuxemi (?) Hall (?); Chonetes mucronata Hall; Productus lachrymosus, var. limus Conrad; Productus speciosus; Spirifera disjuncta Sowerby; Spirifera Engelmanni Meek; Rhynchonella pugna Martin; Rhynchonella sinuata Hall; Rhynchonella tethys Billings (?); Atrypa reticularis Linnarsson; Ambocoelia umbonata Conrad; Athyris hirsuta Hall; Athyris sp. (?); Aviculopecten; Grammysia, 3 sp.; Modiomorpha; Nucula; Schizodus.

LIST NO. 2. — Streptorhynchus chemungensis Conrad; Spirifera sp. (?); Rhynchonella Horsfordii Hall (?); Athyris hirsuta Hall.

Mr. Walcott says, "Of the twenty-three species of fossils given in lists 1 and 2, twelve are identical with species occurring in the upper Devonian of the Eureka district, Nevada: of the others, two are upper Devonian species in New-York state, and Athyris hirsuta occurs at the base of the carboniferous, in the Eureka district. There is also a species of Athyris too imperfect for determination. The remaining forms are lamellibranchs belonging to five genera; and the species closely resemble those of the lower carboniferous, of the Eureka district." The latter were obtained from the upper portion of the bluff from which the specimens were obtained.

A. C. PEALE,
U. S. geological survey.

The Hall effect.

About a year ago Mr. Shelford Bidwell published a table intended to show that the direction of the magnetic rotation of the equipotential lines of an electric current in any given metal could be inferred from the sign of the effect produced by stress upon the thermo-electric property of the metal.

Although Mr. Bidwell's attempted explanation of the former effect by means of the latter has proved entirely inadequate, the table published is nevertheless interesting and suggestive. It appears, however, that the law indicated in this table is not perfectly general. Mr. Coggeshall and Mr. Stone of the present Harvard junior class, working with my co-operation at the Jefferson physical laboratory, find that French cold-rolled steel would form an exception in Mr. Bidwell's table, acting in the thermo-electric test like copper, but in the other test like iron. Their examination of copper and iron confirms Thomson's results with those metals, and, as a necessary consequence, Mr. Bidwell's table.

The students have examined only these three metals as yet, but will probably extend their investigation to others. E. H. HALL.

Cambridge, March 20.

P.S. — We have now taken a strip of aluminium, cut two pieces from it, and tested one of these pieces for the transverse effect, the other for the thermo-electric effect. The transverse effect is like that in copper. This agrees with the result of my previous examination of aluminium, but does not agree with the result obtained by Mr. Bidwell. The thermo-electric effect was like that in iron. This does agree with the result found by Mr. Bidwell. Hence this specimen of aluminium, which is not the same that I originally used, makes another exception in Mr. Bidwell's table. E. H. H.

JOHN BLOOMFIELD JERVIS.

THE subject of this sketch, one of the most eminent of American engineers, died at Rome, N.Y., Jan. 12, 1885, after a long life, distinguished for the prominent enterprises with which he had been connected and to which he had given many features they still retain. He was noted for his purity of life, and professionally for his caution, accuracy, sound judgment, and integrity. His engineering training was not obtained in any technical school, such as is offered to the youth of the present day, and his preparatory education was extremely moderate in amount.

John Bloomfield Jervis was born at Huntington, Long Island, Dec. 14, 1795, and was the oldest of seven children. His father was a carpenter, who in 1798 removed to the neighborhood of Rome, N.Y., and engaged in sawing lumber. The son attended the common school of that date until he was fifteen years old; and for the following seven years he worked at the saw-mill, on the farm, and in the woods. In 1817 the construction of the Erie canal through that region brought about his employment as axeman on the work, and first turned his attention to engineering. He was soon promoted to rodman, and in two years was made resident engineer of a section of seventeen miles, from Canastota to Limestone Creek. He gave such satisfaction that in 1821 he was assigned to a similar position near Amsterdam, and was retained, after the opening of the canal, to superintend repairs.

A condensed statement of the more important of his professional engagements, which are described at greater length in the *Railroad gazette* of Jan. 23, will give an idea of how active and responsible a position in life he has occupied. In 1825 he became chief engineer of the Delaware and Hudson canal company, and remained until 1830. He constructed the inclines of the Carbondale railroad, and ordered from England the 'Stourbridge lion,' the first locomotive imported into this country. In 1830 he was made chief engineer of the Albany and Schenectady railroad, the first railroad constructed in the state of New York, and, later, of the Schenectady and Saratoga railroad. Here he devised the four-wheeled, swivelling or 'pony' truck used for the leading wheels of a locomotive, and generally adopted in this country. In 1833 he was chief engineer of the Chenango canal, ninety-eight miles in length, with a hundred locks, where he originated the use of artificial reservoirs for the supply of the summit level. In 1835 he made surveys and estimates for an enlargement of the eastern section of the Erie canal. He was made chief engineer of the Croton aqueduct in 1836, — a work considered, at the time of its completion, as a magnificent example of hydraulic engineering, and in which the Croton dam, High bridge, and the 42d-street reservoir show his professional skill. From 1846 to 1848 he was consulting engineer on the Cochituate aqueduct, Boston water-supply. Water-works at Port Jervis and at Rome, N.Y., were later constructed under his supervision. Between 1847 and 1850 he was first chief and then consulting engineer of the Hudson-River railroad when it was completed from New York to Poughkeepsie, a portion covering most of the difficult work of that line. After a short trip to Europe, he became chief engineer on the construction of what is now the western part of the Lake shore and Michigan southern railroad, and was connected with this road until 1858. During 1851 he was made president of the Chicago and Rock Island railway. In 1861 he became general superintendent of the Pittsburgh, Fort Wayne, and Chicago railway; in 1864 was made its chief engineer, and in 1866 its consulting engineer, — a position he held until 1872. In 1868 he was connected with the organization of the Rome iron-mill company, and was its secretary from 1872 until his death.

After retiring from active work in the field in 1866, he wrote a book on 'Railway property,' and another on 'The question of labor and capital.' In 1868 the American society of civil engineers elected him an honorary member, and in 1878 Hamilton college conferred on him the degree of LL.D. Mr. Wil-

liam P. Shinn, in the sketch of his life in the *Railroad gazette*, says, "His last professional work, and that which most fully illustrates the extraordinary character of his professional ability, and the esteem in which he was held by his engineering contemporaries, was his employment as a consulting engineer on the proposed new Croton aqueduct. . . . That he should be equal to this work at the age of eighty-six was sufficiently remarkable; but that he should be considered as worthy of being consulted by men themselves veterans in the profession, is a still more extraordinary evidence of the exceptional character of the man."

His health and his faculties remained unimpaired till near the close of his life; and he died of old age, in his ninetieth year.

THE NEW PALACE AT SÖUL.

Such is the name of that collection of grounds and buildings in Söul which is at present the abode of the reigning sovereign of Korea. Strictly speaking, the title is in both parts a misnomer: for the place so called is neither new, nor is it exactly what in western parlance would be styled a palace; and yet to Korean thought it is both. Its age is comparative merely, as indeed must be that of every thing which does not contain within itself a term of life. In this case, the comparison is with what is now known, in the same antithesis, as the Old Palace. But there is also a certain absolute justice in this last name; for the Old Palace could not possibly be any older where it is. It is coeval with the beginning of the present state of things, dating from the founding of the city of Söul, now hard upon the five-hundredth anniversary. The New Palace was laid out some hundred years later, and is therefore about four centuries old at the present time. In consequence of being later built, it occupies a somewhat less honorable position than the older one; for even position has its allotted ceremonial in Korea. North, east, west, and south, — this is the relative rank of the four cardinal points. In etiquette the sovereign always faces the south, and his subjects look to the north. Following the same rule, the post of honor generally, on all occasions of ceremony, such as dinners or feasts, is at the northern end of the room. A singular practice this, of determining by exterior terrestrial phenomena the etiquette of entertainments carried on within four walls, which are themselves in no wise subjected to orientation, and may face any direction indifferently, according to the fancy of the owner.

When the city of Söul was laid out, therefore, the palace was given the post of honor, — the northern end of the space enclosed by the city's wall; and, when the second palace came to be built, it was placed as nearly north as was possible consistently with the position of the older one, to whose left, reckoned as facing the city, it lay.

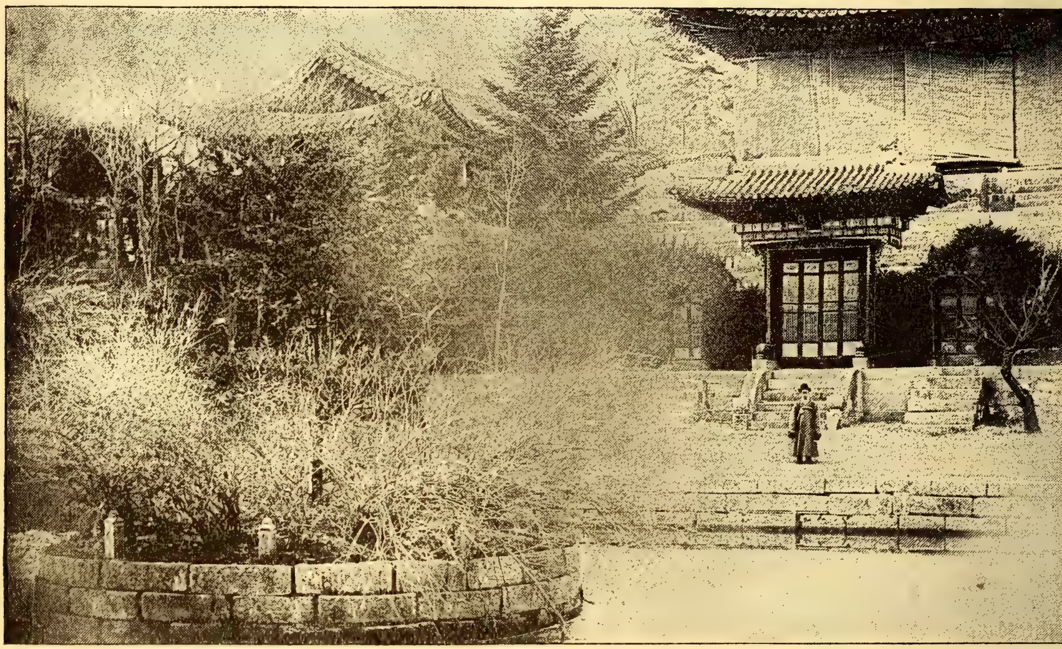
Exactly what was the origin of this custom of allotting a rank among themselves to the cardinal points, it would be interesting to know. We may, perhaps, look to some rude astronomy for an explanation. Like the pyramids, it may, in its way, be the relic of an old study of the stars. Certainly early man could hardly fail to be struck by the sight, that, while all else in the heavens moved, the pole alone remained in dignified repose. The Koreans themselves suggest a more earthly origin for the practice. Because the south is the bright, the warm, and therefore the happy, region of the earth, they say, the king sits so that he may always face it. When we call to mind the cold winters of those lands whence the far-eastern peoples migrated, as well as those to which they afterwards came and now inhabit, we realize how instinctive this turning in body, as in thought, toward the south, would naturally be.

The New Palace was originally built as a residence for the crown prince, or, to speak more accurately, the heir apparent; for in Korea the heir to the throne is chosen by the king during his life, and is not necessarily born to the position, though it is customary for his majesty to so designate his eldest son. This is no doubt a reason for the superiority, architecturally, of the other, the older one. But the newer possesses a charm of its own, first from the uneven character of the ground over which it rambles, and secondly from being much less artificially laid out. It is also somewhat the larger of the two in the extent of ground it covers. The high wall which surrounds it encloses about ten thousand acres. In this wall are set gates at various points, fourteen of them in all. There is no symmetry in their arrangement; nor is there any in the line of wall itself, which meanders about in so aimless a fashion as to cause surprise when at last it ends by meeting itself again. The gates, or archways, are quite as various in size and honor as they are unsymmetrical in position, — a fact typified by their names, which range through

all the grades of esteem, from that of 'the gate of extensive wisdom' to 'the moon-viewing gate.' The fourteen are only outer gates; within are innumerable others; and no gate is without a name. Sometimes the names are simply aesthetic; sometimes they are moral sentiments taken from Confucianism. The inner life of the people is so entirely in theory only a mixture of the two ideas, — the good and the beautiful, — and the veneration for a name so universal, that there is no structure above the most ordinary kind but has its distinct ennobling proper name.

Then, as to thes econd half of the title, — the term a 'place.' The place is not so much a palace as a collection of palaces. Within is a very labyrinth of buildings, courts, and parks. There are audience-halls for the king and the heir apparent; then the separate palaces in which they respectively live; then the queen's apartments, whose size may be imagined from the several hundred court-ladies of various positions, who are constantly in attendance upon her, and whom no male eye save his Majesty's is ever permitted to see. Each of these sets of houses is approached by its own series of courtyards and dependent buildings.

But perhaps the chief beauty of the spot lies in the grounds, half gardens, half parks, which occupy the space not otherwise built over. It is a peculiarity of the far east that the domestication of nature — to use a term which seems best to express the artificial shaping of nature to man's private enjoyment — is carried to the happy halfway point between the two extremes common with us, and which are represented by the park on the one hand, where we shape very little, and the flower-garden on the other, where we mould a great deal too much. The grounds that a Korean delights to wander through are an adaptation or a copy of the features of a real landscape, reduced to a convenient scale, or left of the natural size, according to circumstances, and introduced where he desires them to exist, but are in no sense the conventional museum style of arrangement we display in the fashioning of our flower-gardens. Nothing would strike them as more inartistic than a collection of plants, however beautiful individually, arranged in a manner so wholly unnatural. With them such a collection can be seen, and can only be seen, in the show-grounds of a florist, and affects them as an ordinary shop-window does us. In consequence, they more particularly affect the flowering-shrubs to a comparative neglect of the annuals. Perhaps nature has aided them to the custom by producing the



LOTUS-POND AT THE NEW PALACE IN SÖUL, KOREA.

finest specimens of such shrubs to be seen anywhere in the world.

Scattered through the half garden, half park, are artificial ponds, called 'lotus-ponds,' set in a curbing of granite, with islands bordered in like fashion. In the same manner the brooks are confined and fringed, and are spanned by stone bridges at intervals; and yet so well done is the work that it seems in keeping with its surroundings. At all points where a particularly pretty bit of landscape presents itself, is found a summer-house; for a Korean does not combine the idea of exercise with the enjoyment of nature, and prefers to drink in the scenery where at the same time he can sip his tea.

Throw over the greater part of the scene the artistic touch of neglect and incipient ruin, and you have some idea of the grounds of the New Palace of Söul. PERCIVAL LOWELL.

THE YUCHI TRIBE OF INDIANS, AND ITS LANGUAGE.

THE ancient domain of the Yuchi or Uchee tribe on both sides of Middle Savannah River probably does not shelter any full-blooded Yuchi man or woman at the present time; but in the remote corner of the Indian Territory, where the tribe is settled now, it tenaciously clings to its ancient customs and habits, its beliefs, dances, and busk festivals. Very few of this aboriginal colony on the southern banks of the Arkansas River can converse intelligibly in English: they do not even mix a great deal with the Creeks, by whom they are surrounded on all sides, but live quietly and happily on their farms. Their myths consider the sun as a female, and the Yuchi as her children. When the last Yuchi dies, the whole world will become extinct also. The moon is regarded as of the male sex, and as the suitor of the sun.

Although the Yuchi tongue differs in its radicals from all American languages heretofore explored, it exhibits some general resemblance in structure to Creek and the other dialects of the Maskoki family. It is possessed of the same alphabetic sounds as this, but shows slight differences in their utterance, and is as prone to nasalize its vowels as Cha'hta and the Sioux dialect of Dakota. Syllables and words close with vowels almost throughout; and the structure of the syllable is, quite as invariably as in Ojibwē, one or two consonants followed by a vowel, diphthongs being rare and always adulterine. The mute consonants do not show the tendency of Creek to be uttered at the alveolar or front part of the palate. A large number of terms are oxytonized, that is, emphasized on their last syllable; but the Hottentot clucks, which have been attributed to the Yuchi language, do not exist in it. None of the nouns inflect for case. The adjective does not inflect for number; but the substantive nouns assume the ending *ha*, which I suppose to be abbreviated from *wahále* ('many'), a term which also appears as *hále*. The decimal system forms the base of the numeral series, and not the quinary, which is the most frequent one in America and in other parts of the world. The existence of a dual generally shows that a language has remained in a highly archaic state; but in Yuchi no trace could be discovered of it, neither in the noun or pronoun, nor in the verb, although the Maskoki dialects possess it in the latter. The verb has a personal and temporal inflection, but is not by any means so rich in tense forms as Creek, Cha'hta, or Hitchiti. But like these, it reduplicates the second syllable of the verbal base to form iterative, frequentative, and distributive forms of conjugation. In the third person of the pronoun, distinction is made not only between male and female, but also between races: since 'they,' when referring to whites or negroes of both sexes, is expressed by *lewénu;* when referring to Indians, by *lehénu.* 'She,' when pointing to an Indian woman not related to the one speaking, is rendered by *léno;* when related to him, by *lesséno.* All these gender distinctions are also expressed in the intransitive verb.

The gentes of the Yuchi people are identical with those of the Creeks and Seminoles, and, like the Náktche gentes, are evidently borrowed from them. The descent is therefore also in the maternal line. ALBERT S. GATSCHET.

RECENT INVESTIGATIONS UPON CHOLERA.

THE cessation of the cholera epidemic in Europe, since the advent of cold weather, has prevented the occurrence of much of interest in this direction since our last notice of the subject in *Science.* The English cholera commission, a note of whose labors was made some weeks ago (vol. v. p. 41), has returned, and has made a full report of its labors, which seem to contradict Koch's assertions in every vital point. We had hoped to receive the printed report before this, but have failed to do so as yet.

The most interesting work upon the comma bacillus of cholera, recently published, is that of Johne (*Zeitschr. f. thiermed.*, xi. 87), in which he gives the methods of culture, staining, and preparation of the

organism, and emphasizes its differences under cultivation from any of the other bacteria yet compared with it, paying especial attention to the bacillus of Finkler and Prior. To emphasize the difference still more, he gives figures illustrating the different appearances of the cultivations of the two organisms, and the different ways in which they liquefy the culture-material (*nahr-gelatin*). This work of Johne's is of such special interest just at present, that we feel justified in announcing that it may be purchased in separate form of C. W. Vogel, in Leipzig.

Buchner (*Münch. ärztl. intell.*, 1885, 549) finds a constant difference between Koch's and Finkler and Prior's organisms under cultivation, and adds his testimony to the effect that confusion of the two should be impossible. Doyen (*Soc. biol.*, Dec. 13, 1884) gives an account of various forms of bacteria, observed microscopically and under cultivation, in seven cases of cholera. These were found in the liver and kidneys; but as no data are given as to when the post-mortem examinations were made, how soon after death, etc., and as no inoculation experiments are as yet announced (as far as we have seen), the author is hardly justified, from these observations alone, in heralding 'the end of the reign of the comma bacillus.'

Pettenköfer's challenge to Koch, for it really amounts to that (*Deutsch. med. wochenschr.*, 1884, 818), has not yet been accepted, as, for various plain reasons, it probably will not be. This was, in effect, to produce twenty or one hundred volunteers besides himself as subjects for experimentation, to allow a preliminary gastro-intestinal catarrh to be produced, and then to swallow any reasonable amount of a pure culture of the cholera bacillus. Such a challenge as this may be effective, but naturally is not scientific for the reason that no such experiments can be carried on with precision.

Turning to subjects not immediately connected with the discussion of the specific bacterium of cholera, there have been some contributions to the literature of the subject worthy of attention. Villiers (*Comptes rendus*, 1885, 91) speaks of an alkaloid (ptomäine) found in the cadavers of two persons dead of cholera. It was found in notable quantity in the intestines, and in much less amount in the kidneys, liver, and heart's blood. It is liquid, has an acrid taste, and a distinct odor of hawthorn. It is alkaline, and an active base, set free by alkalies, but not by the alkaline carbonates. Iodide of mercury and of potassium give a white precipitate with its solutions and those of its salts. Picric acid gives a yellow, and chloride of gold a yellowish-white precipitate. Concentrated solutions give a white precipitate with tannin and bichloride of mercury, but chloride of platinum and bichromate of potash give no precipitate. Ferrocyanide and perchloride of iron give a very slight and slowly appearing precipitate. Sulphuric acid placed in contact with the alkaloid gives a very faint and quickly disappearing violet color. The chlorhydrate of the alkaloid is neutral to litmus-paper. It crystallizes in long fine transparent needles, which are exceedingly deliquescent.

Then follow certain physiological experiments, limited in number by the small quantity of the alkaloid at command. The effects produced were a remarkable variation of the pulse-beat, contractions of the limbs, anorexia, and death in four days, of the animal experimented upon (rabbit). Apparently the author did not look for the reproduction of the ptomäine in the body of this animal, — an experiment which would have been of interest as tending to show whether it were connected with the growth of any special micro-organism. The author proposes to continue his investigations as to the occurrence of other special alkaloids in acute diseases, especially in typhoid-fever. He offers a pregnant suggestion in this connection, that, if it turns out that these diseases terminate by the formation of these poisons (ptomäines) in the system, it may be possible to administer antidotes continuously until the cause of their production has disappeared, — thus, for cholera, the continuous administration of iodine-water to form an insoluble compound with the alkaloid; or, if this prove too irritating, the iodide of starch might be used.

Rivière (*Comptes rendus*, 1885, 157) gives a short statistical review of the cholera epidemic in Paris. From Nov. 4, 1884, to Jan. 15, 1885, the dates of the first case admitted and the last discharged from the Paris hospitals, there were 1,080 cases, — 636 males and 444 females. From these a small number must be deducted for errors of diagnosis. There were 587 deaths, or 54.15%. Of the men, 340 died, or 53.46%; and of the women, 247, or 55.63%. These figures reduce the percentage, as given in *Science* (v. 33), somewhat, but at the same time show that the mortality was no lower than usual in epidemics of cholera, and certainly not so low as has been indicated.

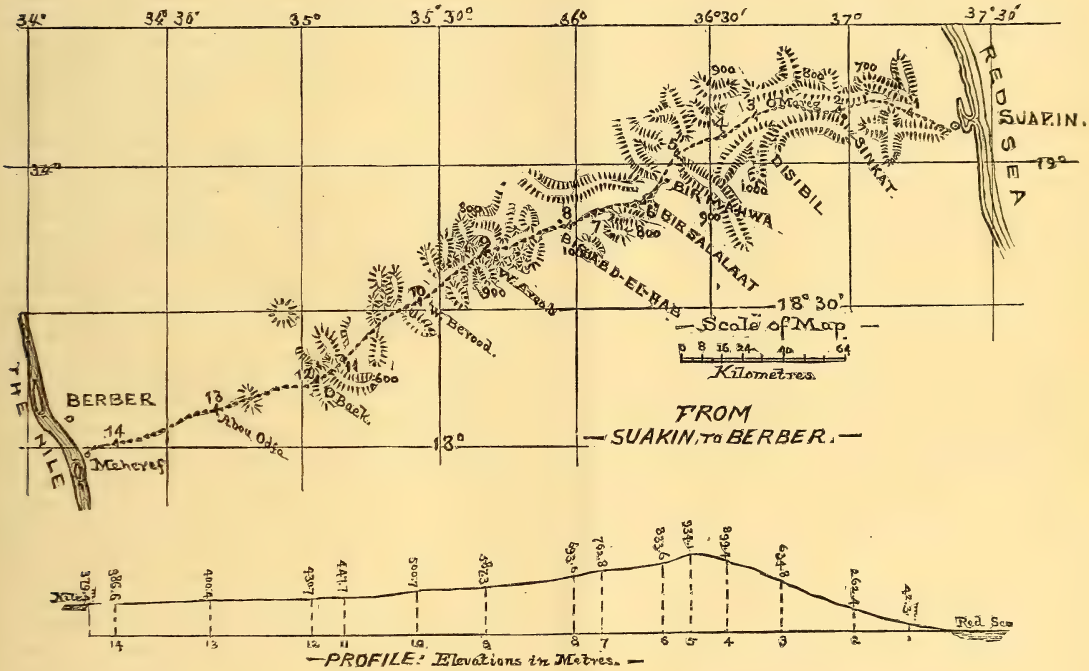
Pouchet (*Comptes rendus*, 1885, 220) speaks of the results of investigations upon the modifications undergone by certain secretions under the influence of cholera. He worked upon the bile, the dejections of the cold period, the urine, and the blood. He gives some further account of the ptomäine spoken of above, and a very interesting history of its poisonous effects upon himself during its preparation.

FROM SUAKIN TO BERBER.

Since the repulse of the English forces on the march to Khartum by the way of the Nile, attention has been drawn anew to the possibility of constructing and operating a railroad-line from Suakin to Berber. A line of some two hundred and fifty miles in length would easily bring the produce of the Sudan to a seaport. And the reasons why it has not been constructed heretofore are stated to be, that "Egypt had no navy. The khedive did not wish to put the key to the Sudan in the hands of the sultan, or of England, or Italy; nor did he wish the commerce of the Sudan to be diverted from the Nile valley." The military necessities of the situation have now, how-

ever, caused England to set about the undertaking; and work on the road has begun. The gauge, after some discussion of the relative merits of three feet, three feet six inches, and other widths, has been fixed at four feet eight inches and a half, probably with a view to permanency. It will be necessary to use iron sleepers, as the ants destroy wood rapidly.

The question of a water-supply on the route is a very important one. Col. H. G. Prout, an American engineer, formerly in the employ of the khedive under Gen. Stone as chief of the geographical and topographical section in the general staff bureau at Cairo, contributes to the *Engineering news* of March 7, 1885, an account of a reconnoissance of the Suakin-Berber route made by him in April, 1875, and gives a map and profile of the route, the essential features of which are reproduced here. This profile is stated to be the first one published outside of Egypt; and the *Manchester guardian* speaks of his report as giving the best information possessed in regard to the line. The survey was made with care; the longitudes of the termini were taken from the best maps, and checked by chronometer; the latitudes were determined by his own observations; the line of the route was kept by prismatic compass-bearings and by marching-time; observations for altitude were made with two aneroid barometers, and carefully reduced. As the survey was made in April, and as there had then been no rain for two years, the English will now find much the same condition of things as that which he describes. From his communication the following points are condensed: —



Two miles inland from Suakin are wells which yield the only water for the town. For fifteen miles the route lies over a plain of gravel and small bowlders, and rises about eight hundred and fifty feet above the sea in that distance. A number of shallow beds of water-courses cross this plain, dry except for short and infrequent periods, as there is often no rain for two or three years. There is no vegetation, except some small acacias six to twelve feet high. In this distance wells are found at two places, each sufficient for from three hundred to five hundred men and their animals. Then the line enters the mountains, and passes for five miles through a valley varying in width from one or two miles to the bowlder-bed of a mountain torrent. Here at Sinkat, a thousand feet above the sea, are the wells of Hambuk, — water-holes three feet deep, filling slowly, and kept drained by two hundred men and their horses, and three hundred camels. Thirty-two miles from Suakin is the divide between the valleys of Sinkat and O-Mareg, sixteen hundred feet above the sea, and presenting the first difficulty in building a railroad, as for some miles the pass is narrow and crooked, and the grades steep. Masonry to protect the road-bed from the torrent will be required, and rock-cutting may be necessary. The defile is a very bad one to pass in the face of an enemy. Thence the route lies through small valleys, with a growth of low trees and shrubs for

thirty miles, passing wells sufficient for one hundred or two hundred men only, and reaching, about sixty miles from Suakin, beyond Wady Ahmed, the summit of the line, three thousand feet above the sea, — a short but steep and narrow pass, and the most formidable obstacle on the route. Some heavy cutting will be unavoidable, unless another pass can be found. Wells at sixty-two and seventy-five miles from Suakin furnish a large quantity of good water. This portion of the route lies through barren, treeless valleys, strewn with fragments of trap and porphyry. At eighty-seven miles from Suakin is a steep, winding pass, altitude about twenty-five hundred feet above the sea, the last point offering any difficulty for a railroad. Nine miles beyond is the good well of Abd-el-Hab; and then, excepting two or three insignificant water-holes, we find only barren plains and low granite hills to Wady Ariab, — a hundred and eighteen miles from Suakin, and nineteen hundred feet above the sea. Here there is a genuine oasis, with good grazing. Twelve miles beyond, the mountains decline, and the route passes over barren plains for forty-two miles to the sand-dunes of O-Baek, about five miles across, where can be obtained a little water. In the preceding fifty-four miles there is no water. From O-Baek to the Nile, sixty-eight miles, stretches a stony plain without tree or herb, and with no water except at one good well two hours' march from the Nile. For seventy-five miles from Suakin, at no one point could a force of two thousand or three thousand men, with their animals, find sufficient water; and, after leaving Bir Ariab, there are two absolutely waterless stretches of fifty miles each.

To supply the water for the workmen while constructing this railroad, and for the troops which will be needed as guards, as well as to provide for the permanent working of the railroad, a pipe-line is at once to be laid, to consist of two lines of four-inch pipes, with stations every twenty-five or thirty miles, at which pumps will be connected with power sufficient to force the water, under a pressure of some one thousand to fifteen hundred pounds on the square inch at the pumps, so as to give a flow of about a hundred and fifty gallons per minute. The pipes will be laid in curves to allow for expansion from the excessive heat. The pumps are to be supplied by H. R. Worthington of New York, who has had great success in pumping petroleum through pipe-lines in this country under similar circumstances of distance and elevation to be overcome. In some cases their pumps have forced oil over a hundred miles without the assistance of intermediate stations. They are to be delivered in London in thirty days from the date of the order. It is also reported that the contract for laying the pipe has been offered to a New-York contractor of experience in that work, and that a man in Winnipeg, once an officer under Gen. Wolseley, and skilled in American methods of rapid railway-construction, has offered to build and guarantee the opening of the railroad from Suakin to Berber within five months from the signing of the contract.

Our enterprising countrymen are also urging upon the English government the advantages to be gained by the use, on the Nile, of the small, stern-wheel, light-draught steamboats so commonly employed on our western rivers. These boats are equipped with powerful capstans and warps for hauling them up rapids, as well as derricks for working off or over sand-bars, and can be rapidly built in the western yards and shipped in sections, or can be built abroad from plans.

THE TOPOGRAPHY AND GEOLOGY OF THE HUDSON-BAY REGION.

From Dr. Bell's report of the geological work of the Hudson-Bay expedition, we learn something respecting the topography and geological formation of that region. In passing northward along the Labrador coast, the land ascends until within seventy miles of Chudleigh, where a height of six thousand feet is reached: beyond this point it again descends gradually to the cape, which has an elevation of fifteen hundred feet. The highest land of the peninsula seems everywhere to lie close to the coast, with a gradual slope westward down to the comparatively flat basins of the Koksok, and the rivers emptying along the east coast of Hudson Bay. The coast of Labrador, like that of northern Europe, is indented by deep and narrow fiords, and in some places has shoals extending out about five miles. In the strait the coast-line appears to be less irregular, the coast is lower, the hills more rounded, and the country devoid of timber, of which the northern limit barely reaches Ungava Bay.

Throughout northern Labrador and the strait the formation is of gneiss, most of it Huronian, but some of it, perhaps, of Laurentian age, varying in color from gray to red, traversed at some points by dikes of trap, at others by veins of quartz, accompanied by the rock-formations usually found associated with such gneiss, and containing minerals characteristic of the formation, such as labradorite, anorthosite, calc-spar, iron-pyrites, and mica and felspar crystals. No economic minerals were found *in situ;* but at Ashe's Inlet some Eskimo from the eastward brought with them plates of good light-colored mica, pieces of pure foliated graphite, and one of amorphous graphite, all of which they said could be had in large quantities. On being shown specimens of minerals likely to occur in the formation, they recognized a bright-red hematite as existing inland, as well as a coarse variety of soapstone, which had been used for making pots; they also knew quartz, which they distinguished by its superior hardness from specimens of marble and gypsum shown them.

At Stupart's Bay, beaches of shingle may be seen at all levels, up to the tops of the highest hills in the vicinity, all as fresh-looking as those on the present shore, except that the stones are covered with lichens. At Port DeBoucherville the gneiss lies in island-like hummocks, the valleys being filled with bowlder-clay, which has a structural arrangement parallel to the walls, apparently due to a process of expansion, con-

traction, and heaving, in consequence of the severe frost. In narrow gorges this action had the effect of separating the bowlders from the clay, and throwing them to the centre into rows so regular as to suggest design. Mansfield Island is low, and, from disintegration of the rocks, looks like one gigantic ridge of gravel, the solid rock showing through the *débris* only at intervals. The formation is of gray limestone, in thin horizontal terraced beds, containing fossils, probably Silurian. Southampton Island is very similar, but appears to support a little more vegetation. At Marble Island, diorites and schists of the Huronian series are found; and the island probably derives its name from the white and light-colored quartzites of which the whole of the western part consists, and which bear a strong resemblance to white and veined marble. The surfaces of the beds are often strongly ripple-marked.

In considering the glaciation of the district, Dr. Bell remarks, that, if the sea here were only a hundred fathoms lower than at present, James and Hudson bays would be a plain of dry land, more level in proportion to its extent than any other on the continent. The numerous rivers that flow into it would traverse this plain, after having converged into one immense river towards the eastern limit of the plateau, and would empty into the strait near Digges, the strait remaining as a large bay, very much in its present shape.

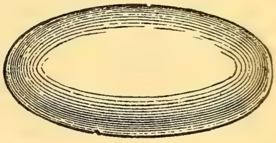
During the 'great ice age,' the basin of Hudson Bay may have formed a sort of glacial reservoir, receiving streams of ice from the east, north, and north-west, and giving forth the accumulated result as broad glaciers, mainly towards the south and south-west. In the strait, the direction of the well-marked glaciation is invariably eastward; and the composition of the drift, which includes Huronian limestone fragments similar to the more westerly formations, as well as the long depression of Fox's Channel and the strait, deepening as it stretches eastward, all point to the passage of an extensive glacier into the Atlantic. This glacier was probably joined by part of that occupying the site of Hudson Bay, and by another, also from the southward, coming down the valley of the Koksok River and Ungava Bay; these united streams still moving eastward, round Cape Chudleigh, into the ocean.

Throughout the drift-period, the coast-range of Labrador held its head above the ice, especially the high northern part; but, in going south, glacial action seems to have reached a height of a thousand feet at least. Here the course followed by the ice is down the valleys and fiords directly into the sea; while, on the island of Newfoundland, it appears to have been from the centre towards the sea, on all sides.

BIOLOGICAL NOTES.

ONE of the principal distinctions between the mammalia and the lower vertebrata has been hitherto supposed to be the possession by the former of a placenta. Duval, however (*Journ. anat. physiol.*, 1884, 193), has come to the conclusion that it also exists, though in a rudimentary form, in birds. The allantois, passing inward into the pleuro-peritoneal cavity, does not become attached to the amnion or the umbilical vesicle, but joins the chorion, becoming fused with it. It ends by forming a sac, which encloses a mass of albumen; and into this sac the villi of the chorion project, forming an organ completely analogous to the placenta of the mammalia. There is necessarily a difference in the form of this organ, due to the different modes of reproduction; in mammals the villi of the chorion being attached to the mother, while in birds they must attach themselves to the nutritive albumen. It is, however, quite intelligible, that in an ovoviviparous vertebrate, where the egg has a thin membranous shell, the placentoid organ should become attached to the internal surface of the oviduct. This placenta of birds is therefore a rudimentary organ which enables us to understand how the placenta of the mammalia may have originated.

For over sixty years Ornithorhynchus, or the duck-billed Platypus, has been believed to be oviparous; but up to the present time the evidence has not seemed to naturalists sufficient to settle this point beyond a doubt. In 1829 Geoffroy St. Hilaire, in a communication upon the subject, described the eggs as being of a regular oblong spheroidal form, of equal size at both ends, and measuring an inch and three-eighths in length and six-eighths of an inch in breadth. It seems now to be established, that these eggs, two in number, are laid at the end of a burrow in the river-bank, about twelve yards from the water. The ovum of monotremes bears a close resemblance to that of a sauropsidan, and is very different from that of a true mammal, in that it has a good-sized yelk with which the young is nourished. It is interesting to observe that the yelk-sac and the umbilical vesicle are really homologous. In monotremes we find, as it were, intermediate animals possessing the attributes of two classes: for, on the one hand, they have developed mammary glands, the distinctive feature of the higher group; on the other, they lack that structure whereby the typical mammalian embryo receives nourishment before birth; and, in correlation with this, we find them agreeing with the lower class in the possession of a yelk-sac, whilst the contained food-yelk causes the ovum to assume the meroblastic type. We may thus trace the line of descent through the Sauropsida, directly to the monotremes (doubtless through forms extinct, as the Theromorpha of Cope); from these to marsupials, which are viviparous, but whose ova still possess a large yelk-sac, and whose embryos enter into no close vascular connection with the maternal tissues; and from these to the higher mammals.



In some experiments upon the digestion of sponges, von Lendenfeld kept some Australian Aplysinidae in

water containing powdered carmine. It was noticed, that, although all the cells took up the carmine, the epithelium of the ciliated chambers soon ejected the granules, while the cells of the upper surface of the subdermal cavity gave them off to the amoeboid wandering cells of the mesoderm, which, after they had partly digested the carmine, transmitted it to the cells of the ciliated chambers for ejection. He concluded, therefore, that although all the cells had the power of absorption, as is the case in man, still the digestive function in the species upon which he experimented was centralized in the upper wall of the subdermal cavities. Other authors have held different views; and in a subsequent paper he himself has concluded that it cannot yet be decided whether sponges digest with the ectoderm or the entoderm, though he considers it not improbable that both layers may have that function. His papers will be found in the Proceedings of the Linnean society of New South Wales.

R. von Lendenfeld has also described in the *Annals and magazine of natural history* for December, 1884, a new variety of Medusa which may prove to be a new species evolved within the last forty years. The species is Crambessa mosaica, which Huxley in 1845 described from Sydney, Australia, as blue to gray, but which is now found in this locality distinctly brown in color, due to a parasitic alga which infests the flesh near the surface. The evidence is sufficient to cause von Lendenfeld to state that it is probable that this new variety has been born since Huxley described it in 1845. He also mentions the case of another Medusa (Cyanea annaskala) which has hitherto been found only at Port Philip, where it is abundant, but which has recently been found at Port Jackson in warmer water. Those in the latter place differ from the typical species in being much larger, and, besides, in possessing deep-purple pigment-cells around the mouth-arms, which he thinks may be able to perceive light. He makes a new variety from this variation of color.

THE ANATOMY AND PHYSIOLOGY OF THE BRAIN IN THEIR RELATION TO MENTAL DISORDERS.

TREATISES upon insanity have been appearing recently in quick succession, both in this country and abroad. There is none, however, which will command more notice, and prove more suggestive, than this work.

Professor Meynert, who has been at the head of the department of psychiatry in the University of Vienna for the past fifteen years, was one of the first to advance the opinion that a study of mental disease must be preceded by an understanding of healthy mental action. Regarding mental action as the subjective side of a physiological process in the brain, he seeks primarily to ascertain the function of the organ from its anatomical structure. The logical order which is followed in this work is therefore, first, the anatomy of the brain; second, the physiology of the brain, that is, the mechanism of mind; and, lastly, disturbances of the mechanism, that is, mental disorder.

The first volume is devoted to the structure and functions of the organ of mind. The position which Professor Meynert holds as the founder of modern brain-anatomy entitles him to a respectful hearing on this subject. Since the appearance of his first articles in Stricker's 'Handbook of histology' in 1870, he has been the chief authority in Germany; and almost every one of the younger scientific men who have done original work in this department has been imbued with his enthusiasm by personal contact with him in his laboratory. Within a hundred and twenty-five pages he has succeeded in giving a clear statement of the complex subject of the arrangement and relations of the gray masses and white connecting-fibres which make up the brain. An important aid to the comprehension of the structure will be found in the numerous excellent drawings of dissections and of microscopic sections.

The gray matter of the nervous system is the part in which sensory impulses are received and registered, and in which motor impulses are initiated. The white matter is made up of threads which transmit the impulses without modifying them. The structure and functions of the gray matter differ in different parts; simple functions being performed by that in the spinal cord, more complex functions in the gray masses within the brain, the most complex and the conscious functions being assigned to the layer which is spread out upon the surface of the brain, and which is thrown into folds by its convolutions. Each part of the surface of the body is in anatomical connection, by means of nerve-fibres, with its own part of the surface of the brain; and thus it is not difficult to imagine a projection of a map of the body upon the brain-cortex. The fibres which act in this manner to bring the external world into consciousness are named by Meynert 'the projection system of tracts.' This 'projection system' was announced in 1870, and was the starting-point to which all the recent discoveries regarding the localization of functions in various regions of the brain can be traced. It is to-day the ground-work for many arguments in favor of the theory of localization, — a theory to which Meynert gives his hearty support.

At present, investigations in brain-anatomy

Psychiatrie. Klinik der erkrankungen des vorderhirns begründet auf dessen bau, leistungen und ernährung. Von Dr. THEODOR MEYNERT. Erste hälfte. Wien, *Braumüller*, 1884. 10+288 p., illustr. 8°.

are directed to tracing the course of the tracts which unite the gray masses, and form the parts of the projection system. Owing to the discovery of new methods of investigation, progress has been rapid of late. It is not to be wondered at, therefore, that in regard to some details, the statements of Meynert, which were already in print three years ago, cannot now be accepted; e.g., as to the course of the lemniscus (pp. 94–97), and the connection of the tracts in the spinal cord with those in the cerebral axis (pp. 120–125). The diagram (fig. 58) is especially misleading. It is probably on account of these errors that an appendix is promised, to appear with the second volume, and to contain a review of the more recent discoveries. These minor defects do not, however, impair the usefulness of the work as a general text-book of brain-anatomy; and it is a matter of congratulation to those who are unable to master the very difficult style of the author, that an English translation is soon to appear.

It is by means of the projection system that impulses from without reach the brain-cortex, and become conscious perceptions. To associate these perceptions, and make connected thought possible, there exists a second system of fibres which unites the various regions of the brain-surface with each other. This is the 'association system.' Meynert illustrates the action of these systems by analyzing the simple act of winking. If a pin touches the eye of an infant, the lid closes. This is a reflex act, carried out by a simple mechanism independent of any act of consciousness; but, coincident with the reflex act, a number of impulses are sent along the projection fibres to the brain, which, on reaching the cortex, give rise to the conscious perception of the appearance of the pin, of the pain of the prick, and of the motion which has been performed. Each of these perceptions occurs in a different part of the brain, since each impulse reaches it by a different fibre. But the three occur simultaneously; and, as all parts of the cortex are joined by association fibres, the three perceptions are associated both in perception and in memory. Hence, when the pin is seen again, the memory of the pain arises, and also the memory of the motion which stopped the pain, and thus the mere sight of the object may lead the child to close the eye. The perception of the reflex motion has given the infant the knowledge of the possession of a muscle which will move; and the motion, having once become conscious, can be reproduced voluntarily by an effort which excites to action those cells which retain the memory of the motion (pp. 144–148). Every perception and motion has its appropriate cell; and, lest this should seem to demand too great a number of cells, Meynert has examined the cortex microscopically, and has found that it contains over a milliard of these bodies (p. 140). Each physiological action is attended by the acquisition of a new memory, and, as we go on in life, the number of cells unoccupied becomes less and less; so that it is probable that a physical limit to the power of memory, and consequently to the power of intellectual growth, is determined by the number of cells in the cortex (p. 140). This is the stand-point of an extreme materialist. But Meynert's materialism is not of the theoretical kind: it is based upon facts of observation which cannot be ignored. The structure of the brain, its comparative development in various species, the evolution of mind in animals, the growth of knowledge in children, the results of experimental physiology, and the symptoms of mental dissolution in a class of cases in which disease has reduced the individual to the level of the infant, or even to that of the brute, have been called on to furnish the data for Meynert's mechanism of thought. Psychologists are slowly coming to the conclusion that a wholly subjective method of research is inadequate to settle the questions which for so many years they have been unable to answer, and are beginning to pursue an objective method by studying the development of mind, and the disorders of mind which are associated with actual loss of brain-substance. To psychologists, therefore, this book is of great importance; for it opens up many new subjects, it throws light on many obscure subjects, it settles finally some disputed subjects.

Physiological processes are attended by the consumption of material: hence the nutrition of the brain enters as a factor in mental action. When a part of the brain is exercised, more blood passes to that part than to other parts to supply oxygen as it is needed. The rapidity and quality of the mental process is dependent to some degree upon the proper blood-supply. These are facts determined by experiment on animals and man. Mental labor is attended with a rise of temperature in the brain, an indication of increased oxidation processes. If a dog's brain is laid bare, the vessels are seen to be less distended with blood during sleep than when it is awake. If the dog dreams, the vessels dilate. An abnormal flow of blood to the brain interferes with the natural action of the organ: it may cause an irritation of the cells containing memory pictures, and consequently a conscious perception of the object

remembered by the cells, i.e., hallucinations. So, too, an abnormal lack of blood may exhaust the brain, may render a person incapable of carrying on mental processes, and may even cause such a degree of hunger for oxygen in the cells as in turn to produce irritation, and thus again hallucinations, followed by loss of memory. It is evident that Meynert regards many forms of mental disease as dependent upon abnormal nutrition of the brain, either from hyperaemia or anaemia, — a position in which he by no means stands alone.

The description of physiological processes in the brain forms a fitting introduction to the study of its disorders. This division of the subject is to be taken up in the second volume, which will be eagerly looked for by those who have read the first. It will doubtless be as suggestive and original as this volume.

Meynert's book should be read both by medical men and those interested in the problems of psychology. Its technical parts will be of great service to those who study the minute anatomy of the brain. Its physiological portion is of general interest, and will excite much notice and comment. The facts and the conclusions are entitled to careful consideration, as they are the product of most mature and thorough work, even though the materialistic explanation is at times inadequate. Meynert is not to be placed in the ranks of German philosophers. He does not grapple with the problems of psychology, as Lötze or Wündt have done: he writes from the stand-point of an alienist who seeks to resolve a mental process into its simplest elements, and to detect in any given case of mental disorder the particular element which is lacking. The explanation of the manner in which we acquire the idea of space is unsatisfactory (p. 166). The causal relation is not sharply differentiated from the simple association of ideas by correlation in time (p. 164). The time element in memory is not exhaustively discussed. There are, doubtless, many trains of thought which are largely the simple rising into consciousness of associated memory pictures. There are others which are not to be so easily accounted for, and to which no clew can be gained by a study of association fibres and of variations in the blood-supply. To the psychologist, therefore, this work will be of service only as a collection of facts in one department bearing upon his science, — facts which he must consider, but which by no means carry with them the explanation of the problems involved.

The work raises many questions which the author does not attempt to answer. It would perhaps be unjust to demand from him the attempt, for he does not pretend to be writing as a psychologist. As a study of thought-mechanism, and as an introduction to a study of psychiatry, to which alone it lays claims, it is more satisfactory than any work which has recently appeared.

ENGINEERING GEOLOGY.

It is now generally admitted by mining and civil engineers that a knowledge of the principles of practical geology is necessary for the successful execution of those plans, depending upon a correct conception and understanding of the character of the surface of the earth and underlying rocks, where engineering works, such as bridges, railroads, canals, and even buildings, are to be constructed, and through which, as in the case of railroad-tunnels and mines, excavations are to be made.

The rapid progress which has been made in America during the past fifteen years in practical geology has so completely absorbed the active professionalist, that none of our field-geologists have found time to contribute a treatise to our literature such as Geikie's Field, Penning's Engineering, and Page's Economic geology, Burat's 'Géologie appliqué,' and the more recent work by Wagner, on 'The relation of geology to the engineering sciences.'

This last work is an elaborate and strictly technical discussion of the application of practical geology to tunnel-work and closely related subjects. It contains superior plate (quarto photolithographs) and text illustrations, and will prove a work of great value, not only to professional field-geologists, but to students in practical geology and engineering, in defining some of the more useful and economically important applications of geology to engineering work.

Some of the geological cross-sections in the text clearly illustrate the geotectonic principles referred to, but evidently perpetuate an abominable custom, long since abandoned by the best American geologists, of exaggerating the vertical scale. The chapter on explorations by boring is not up to the standard of our home practice.

The practical examples cited from Wagner's own experience add much value and interest to the work, which would be more useful to

Die beziehungen der geologie zu den ingenieur-wissenschaften. Von C. J. WAGNER, ober-ingenieur und sectionsleiter des Arlberg-tunnels. Wien, *Spielhagen & Schurich*, 1884. 88 p., 65 figs., 24 pl. 4°.

practising American engineers if in a more familiar language.

As stated in the preface, "der ingenieur muss geologische kenntnisse besitzen, aber braucht kein specialist zu sein." His eye should be trained to observe those phenomena which are of importance in determining the structure of rocks; but in special problems he must expect to consult the expert geologist, who will be able to deduce conclusions from data given him by the engineer.

MARTIN'S ELEMENTARY HUMAN PHYSIOLOGY.

AMONG the numerous recently published works of its class, the volume before us easily takes a very high rank. From the pen of a thoroughly trained instructor in biology, it is characterized by great clearness and precision of statement, and, being prepared with the co-operation of an experienced teacher of young pupils, the subject is presented in a simple and attractive way that cannot fail to interest the youthful reader. As an example of the way in which difficult points in anatomy and physiology are elucidated by reference to familiar facts, the following illustration of the protection which the skull affords the brain may be quoted: —

> "If you turned upside down a thin china teacup, wrapped round it a covering of raw cotton, and over this put a thin casing of tough wood, any thing placed under the cup would be protected from blows, jars, and piercing, much as your brain is protected inside the skull."

The enactment in several states, of laws providing that the teaching of hygiene in the public schools shall include instruction in regard to the action of stimulants and narcotics, makes it incumbent upon all authors of text-books of hygiene to devote several chapters to this subject. Professor Martin has, upon the whole, accomplished this portion of his task in a very satisfactory manner, though some of his remarks will probably be read with surprise by practitioners of medicine. Thus we are told that 'the bromide is just as dangerous as the opiate,'—a statement which, however well adapted to accomplish the object of the author in discouraging the use of the drug without a physician's prescription, can hardly be regarded as a strictly accurate therapeutic guide.

The human body: a beginner's text-book of anatomy, physiology, and hygiene. By H. NEWELL MARTIN, D.Sc., M.A., M.D., professor of biology in the Johns Hopkins university, and HETTY CARY MARTIN. New York, *Holt*, 1884. 4+261 p., illustr. 8°.

The long list of diseases which may affect every organ and tissue of the body as the result of alcoholic indulgence is well calculated to strike terror to the heart of the toper, and rather tends to give this portion of the book the character of a temperance tract.

The illustrations are taken from Professor Martin's larger text-book of physiology, also entitled 'The human body,' and are therefore not always perfectly in harmony with the elementary character of the smaller work.

This defect is not, however, of any great importance, and does not prevent the work from being, upon the whole, the best English text-book for beginners in the sciences of which it treats.

NOTES AND NEWS.

THE annual stated session of the National academy of sciences will be held at the national museum in Washington, commencing Tuesday, April 21, 1885, at eleven A.M.

— The island of Formosa, which has recently been the scene of Franco-Chinese conflict, is stated, in Dr. S. Wells Williams's valuable work on China, to have been unknown to the Chinese before the year 1403, about the beginning of the Ming dynasty. As the mountains of Formosa are visible from the Chinese mainland in favorable weather, this appears due to some misconception, which is explained by Réné Allain. It appears, according to this author, who has recently published a work on Formosa, that, before the conquest of China by the Mongols (202 B.C.–226 A.D.), Formosa was already known, but under another name, to the Chinese historians, who counted its people among the 'Manti,' or southern barbarians. It was visited by the Chinese in the year 602, and was known as Liéu-Kiéu, or the Great Loo-Choo. Chinese colonies were established there in the fourteenth century. For two hundred years it took the name of Taï-wan, which it still bears in Chinese literature. In 1624 it was ceded by China to the Dutch, who were driven out in 1662 by a celebrated Chinese pirate known to Europeans as Koxinga, who maintained himself there for some twenty years. His successors made submission to the Chinese government, which subsequently made permanent colonies on the island. Formosa is about two hundred and forty-five miles long, with a greatest width of seventy-six miles. It has an area of some fifteen thousand square miles, and is separated from the mainland by a strait nowhere less than sixty miles wide. It is characterized by possessing a range of mountains of remarkable uniformity in height, and attaining a very exceptional altitude, the peaks ranging between eleven thousand and thirteen thousand feet. There are no good harbors, except for vessels of light draught, as far as known; and the land appears to be rising at a remarkable rate. The Dutch fort of 1624, originally built on an islet at some distance

from the shore, now forms part of Formosa, and under its ruins the water is so shallow that passengers land with much difficulty where was formerly deep water. The old harbor is now dry land, converted for miles into a plain, where was formerly the fine port of Taiwanfu. The island is very unhealthy for Europeans, and subject to earthquakes, but contains no active volcanoes.

— The veteran zoölogists of Cuba — Professor Felipe Poey, who is now nearly eighty-six years old, and Dr. Juan Gundlach, who has completed his seventy-fourth year — are still engaged industriously in studying the fauna of that tropical island. Dr. Gundlach has been publishing his contributions to the fauna of Porto Rico in the Annals of the Spanish society of natural history. The vertebrates (including fishes by Poey) have all appeared, and recently the fresh-water marine mollusca have been issued. Gundlach has been publishing every month eight octavo pages in the Annals of the Havana academy of sciences, — a contribution to the mammals, birds, and reptiles of Cuba, — and is now at work upon the insects, of which the Lepidoptera are almost completed, and occupy already nearly four hundred pages. Poey has published the fishes of the island in the Annals of the Spanish society of natural history, and Arango has discussed the mollusks. It is to be hoped that these still vigorous naturalists will live to see the completion of the work they have undertaken with so much zeal.

— The report of the librarian of Harvard university gives this year a fuller account than we have had before of Ebeling's collection of maps, which is known to be one of the most valuable collections in this country, especially for early maps of America. These maps have now been arranged with the others belonging to the university; and the whole series will occupy at least nine hundred portfolios, of which about three hundred and sixty pertain to America, counting in this seventy-two which hold the coast-survey maps. About one hundred volumes will be collected of maps which may be classed together for binding; and, when these are eliminated, there will still remain about fifteen thousand maps. The Ebeling maps belong principally to the seventeenth and eighteenth centuries, and were collected previous to 1817. The re-arranging will be completed early in the coming year. Meanwhile considerable progress has been made in a descriptive catalogue, written on slips which are kept in drawers near the cases of portfolios. These entries have been completed for the maps of Great Britain, France, Spain, Italy, and Scandinavia. When this catalogue is finished, an historical and topographical index is proposed. The maps in atlases will be eventually included, and perhaps important maps in geographical serials and other books. With this extent of catalogue and index service, it is not probable that questions of historical geography can be settled so well anywhere in this country as in the Harvard library.

— The death of Col. Roudaire of the French army, known so widely in connection with the project of an inland sea, to be artificially formed by flooding the depressed area of the 'chotts' in Algeria and Tunis, will not affect the continuation of the investigations relating to that enterprise. Col. Landas, professor of topography in the military school of St. Cyr, has volunteered to take the place of Roudaire. The latter, who had devoted himself with great energy to the scheme for twelve years, received no pecuniary reward for his labors, and leaves a mother, for whose support those interested have subscribed a little annuity.

— 'Melanic variation in Lepidoptera' was the subject of Lord Walsingham's presidential address before the Yorkshire naturalists' union on the 3d of this month. He calls attention to the prevalence of dark varieties of butterflies and moths at great elevations and high altitudes, and attempts to explain it on the theory of natural selection. He points out, that, while vertebrates living through the winter require to retain in their bodies a sufficient amount of heat to enable them to maintain their existence in the severest climates, insects require rapidly to take advantage of transient gleams of sunshine. "Those males," he says, "whose color enabled them to absorb the heat most rapidly would naturally be the first to harden their wings, and to acquire a degree of vitality sufficient to enable them to commence their flight. If we imagine the emergence of a pale and a dark variety side by side at the same moment, it is more than probable that the paler specimen would remain inactive among the herbage, when his darker companion had already commenced his flight. In unfavorable weather the degree of warmth sufficient to arouse even the darkest varieties might be of very short duration; and, if this were so, the less favored males might be wholly deprived of the degree of energy necessary to enable them to find their females. The shorter the continuance of passing gleams of sunshine, the greater would be the influences brought to bear against them; and each separate instance, however infrequent such instances might be, in which they were thus placed at a disadvantage, would have its effect in diminishing their numbers, promoting the survival of only the fittest forms. If this is so, it is sufficiently obvious that the first males on the wing have the best chance of transmitting their color by an hereditary process to the succeeding generation; and, if these males were always or usually the darkest of the brood, their progeny would also be for the most part dark." In order to test certain questions which would arise in connection with this, he placed several dark and light colored insects on the snow, and found a marked difference in the amount of absorption of heat from the sun, and in the rapidity with which they would make impressions upon the snow.

— The opening of the Antwerp exhibition, fixed for May 3, will have to be deferred, as the applications for space have been so numerous and extensive that the proposed area is insufficient.

— The following is a translation of the text of the regulations respecting vivisection issued by the Ger-

man government. 1°. Experiments on living animals must only be performed in serious investigations, or for purposes of instruction. 2°. In public lectures such experiments must not be performed, unless they are necessary for the full elucidation of the subject. 3°. The preparations, as a rule, must be made before the lectures begin, and not in the presence of the audience. 4°. The experiments must only be performed by qualified professors, or by their assistants on their responsibility. 5°. Experiments which will be equally satisfactory if performed on the lower species of animals must not be performed on the higher species. 6°. In all cases where the experiment can be performed without inconvenience under anaesthetics, anaesthetics must be administered.

— *Nature* states, that, in a paper read before the Statistical society on Feb. 17, Sir Richard Temple endeavored to check the various official returns of the population of China by applying the results obtained from the population statistics of British India. The various statements made by the Chinese government as to the numbers of people under its rule show violent fluctuations, those of the last century and a half varying between 436,000,000 and 363,000,000. These returns, as Professor Douglas pointed out, varied with the purposes for which the enumerations were made. China proper, and India, said Sir Richard Temple, have about the same area, — a million and a half of square miles. Both countries are under similar conditions, physical, technical, climatic, geographical. In both there is a strong tendency to multiplication of the race. In both the population loved to congregate in favored districts, to settle down and multiply there till the land could scarcely sustain the growing multitudes, and to leave the less favored districts with a scanty though hardy population. The average population of the whole of India is 184 to the square mile, and, if this average be applied to China (exclusive of the central plateau), it gives a population of 282,191,600 souls. The writer then compared, one by one, the eighteen provinces of China proper with the districts in India corresponding nearly in physical characteristics and cultivable area; and, summarizing these computations, he found, that, over a total area of 1,500,650 square miles, the population, according to this estimate from the Indian averages, would be 282,161,923, or, say, 183 persons to the square mile, while the latest official returns obtained from China show 349,885,386, or 227 inhabitants to the square mile. The general conclusion, he said, might be that the latest Chinese returns, though probably in excess of the reality, did not seem to be extravagant or incredible, on the whole, if tested by the known averages of the Indian census.

— Lebasteur has invented an ingenious process for determining the thickness of iron plates in boilers, or places where they cannot otherwise be measured without cutting them, which process is described in *Le génie civil.* He spreads upon the plate the thickness of which he desires to find, and also upon a piece of sheet-iron of known thickness, a layer of tallow about a hundredth of an inch thick. He then applies to each, for the same length of time, a small object, such as a surgeon's cauterizing instrument, heated as nearly as possible to a constant temperature. The tallow melts: and as in the thicker plate the heat of the cautery is conducted away more rapidly, while in the thin plate the heat is less freely conducted away, and the tallow is consequently melted over a larger area, the diameters of the circles of bare metal around the heated point, bounded after cooling by a little ridge of tallow, will be to each other inversely as the thickness of the plates. The process is stated to have given, in the inventor's hands, results of great accuracy.

— The approaching publication in Holland of a Dutch work on New Guinea by the former Dutch resident at Ternate, Mr. Van Braam-Morris, is announced. The work is to be edited by Mr. Robidée Van der Aa, who is himself an authority on the subject, and will be accompanied by a map. Mr. Van Braam-Morris succeeded in penetrating considerably to the south during an official tour on the Amberno or Rochussen rivers.

— At the February meeting of the Russian geographical society, Gen. Meyer read a paper on the transcaspian province, Merv, or Akhal-Téké. The paper did not mention any new facts, but dwelt on the barrenness of the country, and on its poor resources for trade, etc. The secretary mentioned the return of Poliakoff, who was present at the meeting, and the further progress of Potanin, who has traversed Ordoz, the country in the great bend of the Yellow River, China, and has found numerous ruins which testify that the country was formerly occupied by an agricultural people. The discussion of the Novaia Zemlia magnetic observations has been intrusted to Mr. Trautvetter, formerly director of the Pavlovsk observatory.

— Arrangements are in progress for a collection of live specimens of tropical fishes at the Indian and colonial exhibition of 1886. This scheme will involve the erection of tanks for the maintenance of water at far higher temperature than that suitable for fishes of the temperate zone.

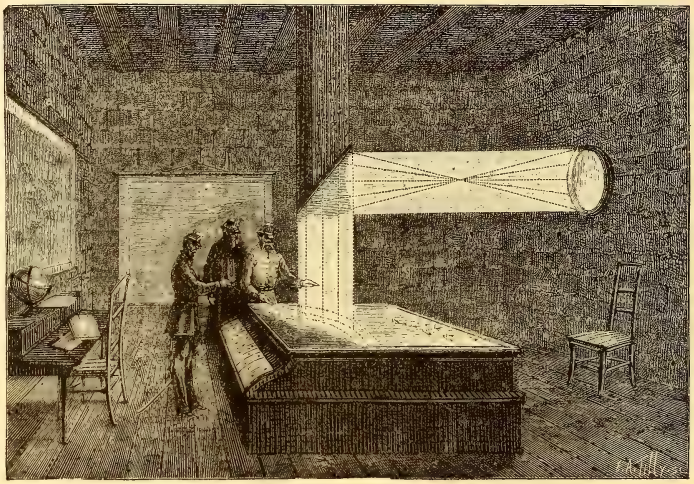
— The largest block of aluminum ever cast is made from American ore, and forms the apex of the Washington monument. It is nine inches and a half high, and measures five inches and a half on each side of the base, but weighs only one hundred ounces. The surface is whiter than silver, and is so highly polished that it reflects like a plate-glass mirror.

— There has recently been considerable agitation in Germany upon the smoke question; and some have suggested that government interfere, and establish 'stoker schools,' through which the stokers of all manufactories shall be obliged to pass before receiving a position. Besides this, it is urged that these manufactories be obliged to build high chimneys. *Engineering,* in a recent number, very sensibly remarks that such a system would be absurd, and further adds that there is no necessity for such action, for, as soon as the difficulties in the way of the introduction of electric lights into dwelling-houses are removed, the gas companies will be forced to reduce

their price; and then the system of gas-heating, which is now being agitated, will be introduced into houses, and finally, without doubt, into factories; and thus the system of pouring out immense quantities of smoke into the air of our cities will cease.

— Dr. Wiese, the German agricultural chemist, recently employed by the government to study suitable vegetables for cultivation in the sandy soil of East Prussia, left Berlin for the Cameroon coast during March. The object of his journey is to study the plants of the country, with a view to their cultivation in Germany.

— During the Austro-Italian war of 1866, in order to protect their ports from the attack of Italian ships, the Austrians placed torpedoes in many concentric circles near the mouths of the harbors. Each torpedo had a separate number, and was connected by a wire with the room represented in the accompanying illustration from *La Nature*, and each wire had a separately numbered key in this chamber. The building in which the chamber was situated was placed on the side of a hill, so as to overlook the port. The chamber was lighted only by a lens, which had a field covering the harbor. The rays of light coming from outside were then reflected into a prism which directed them down upon an unpolished glass plate placed horizontally upon a table, where an image of the harbor was formed. The black marks in the figure point out the exact place of each torpedo, and bear numbers corresponding to those on the keys. An employee watched the plate constantly, and observed every motion of approaching ships. By pressing a button he could at any time explode the corresponding torpedo.



AN AUSTRIAN PLAN FOR WATCHING THE MOVEMENTS OF VESSELS.

— The municipality of Paris has at last approved the suggestion of a grant of land for the new central laboratory of electricity, to be built out of the profits of the Paris electrical exhibition of 1881. These profits amounted to no less than $65,000.

— Among recent deaths we note the following: Mr. John Francis Campbell of Islay, in his sixty-fifth year; Mr. Thomas C. Archer, curator of the museum of science and art, Edinburgh; Mr. Poydessau, French engineer, at Panama, Jan. 7; Louis Godard, aeronaut; Rodolphe Meyer-Dur of Zurich, entomologist, March 2, in his seventy-fourth year; Dr. Julius Münter, director of the botanic garden of Greifswald, Feb. 2; Dr. J. C. G. Lucae, anatomist and anthropologist, at Frankfort a.-M., Feb. 3; H. W. Blair, assistant in the U. S. coast and geodetic survey, at Nashville, Tenn., Dec. 15.

— The Dollfus prize of the Entomological society of France was awarded, on Feb. 25, to Mr. Léon Fairmaire, for his work on the Hemiptera of France.

— The first number of *Mind in nature*, which is 'to furnish in a popular manner information regarding psychical questions,' appeared this month. Those who are willing to accept the marvellous on the slightest evidence will take pleasure in reading the article on metaphysics, by Bishop Samuel Fellows, and that on Christian science, by Dr. S. J. Avery. The article on presentiments is of the same unconvincing character. A paper by Oliver J. Lodge, on experiments in thought-transference, with one or two by Edmund Gurney and others, are reprinted from the Proceedings of the English society for psychical research.

— In No. 180 of the *Zoologischer anzeiger* there are some interesting notes upon spiders by F. Dahl. He claims that their sight is imperfect, except at very short distances; and, in consequence of this, their sense of touch is so well developed, that, when an object falls into their net, they can tell upon exactly which radius the object has fallen, though to ascertain this they must first go to the centre of the web, even though the object may have fallen near their original position. Their smell and hearing are also excellent, the former so much so that they can distinguish odors. The remarkable instinct possessed by the geometrical spiders is shown by the fact that the first web made by the young is perfectly geometrical. That they reflect, is proved by the fact that they despise certain kinds of tough, chitinous insects, which they have unsuccessfully attacked before. This reflection is to be distinguished from the instinctive dread which they have for bee-like flies.

— Prof. S. P. Langley sailed on Wednesday for England, to lecture before the Royal institution.

SCIENCE.

FRIDAY, APRIL 3, 1885.

COMMENT AND CRITICISM.

THE TWO LATEST issues of volumes of observations, astronomical and meteorological, made at the U. S. naval observatory, to which we refer in another column, were received at our office presumably as soon as they were ready for general distribution; and we regret the necessity of calling attention to the delay with which the work of this institution is given to the scientific public. We are informed that this is due in no wise to neglect on the part of any officer of the observatory, but to the repeated exhaustion of the printing-funds annually allotted to the navy department to meet its current needs. However this may be, it is noticeable that the last four volumes — those issued since the delay at the government printing-office is said to have been the greatest hinderance — have only about half the number of pages of many former issues, owing largely to the abbreviated form of presenting the details of observation which the observatory wisely adopted in the volume for 1877.

There would seem to be no good reason why the printing of these volumes, requiring a specific sum each year, should not be provided for independently of the naval allotment of the printing appropriation, just as is now the case with many of the scientific publications of the government which are issued at stated intervals. It is to be hoped that the measure already on foot to secure this result may not end in defeat, as the gain will be great at no increase of expense whatever. The observatory is so far in arrears in this regard, that its foremost work should now be to bring the publication of its work up to date at any cost. The chief reason for making certain classes of observations lies in the expectation of their immediate availability for scientific use; and the publication, in part, of mere results in astronomical journals, does not relieve the inconvenience and uncertainty attending one's inability to refer, when desirable, to the extended details of the work as presented in the complete volumes.

'FLATLAND,' to which we referred a short time ago, besides giving the general reader an easy view of the road by which the mathematician enters the world of n dimensions, contains also a clever picture of the ludicrousness of various social theories now under discussion, when pushed to their legitimate consequences. The inhabitants of that country have the shape of various plane figures, — triangles, squares, pentagons, and polygons, — and the degree of their intelligence is in direct ratio to the number of their sides; so that 'intellectuality' becomes synonymous with 'angularity,' and the circle is a member of the priestly order, — the highest class of all. Beyond the soldiers and the lowest class of workmen, who are triangles with only two sides equal, — a figure so irregular that it can hardly be considered human, — it is a law of nature that each male child shall have one more side than his father.

Evolution is thus a perfectly regular and definite process; and a man's remoteness from the flat apes, his ancestors, can be known by simply counting the number of his sides. Any slight irregularity in a figure is equivalent to a moral imperfection; and to train up a child in the path of virtue is to keep him straight in a literal sense. If he is born with any marked unevenness, he must be taken to one of the regular hospitals for the cure of that disease, or he is in danger of ending his days in the state prison. There is no way of knowing whether a particular delinquency calls for punishment or reward as a means of reform.

The author, a square, confesses that he is at a loss what course to pursue when one of his own hexagonal grandsons pleads as an excuse for his disobedience that a sudden change in the temperature has caused an unequal shrinking in his perimeter, and that the blame ought to be laid, not on him, but on his configuration, which can only be strengthened by abundance of the choicest sweet-meats.

The women in Flatland are straight lines. As they have no angles, they have no intellect; and as they have nothing to say, and no constraint of wit, sense, or reason to prevent their saying it, their conversation is a great bore. To such an extent has the system of female non-education or quietism been pushed, that they are no longer taught to read, nor to master arithmetic enough to count the angles of their husbands or children. The author fears that this policy has been carried so far as to react injuriously on the men, who are obliged to lead a bi-lingual or even a bi-mental existence. They must be able to speak not only the female language of emotion, but also the male language of science, in which 'love' becomes 'the anticipation of benefits,' 'duty' becomes 'necessity' or 'fitness,' and other words are correspondingly transmuted. In the presence of women, moreover, the language used implies the utmost deference for their sex; but behind their backs they are both regarded and spoken of as being little better than 'mindless organisms.' The strain of this dual existence, it is believed, has some tendency to enfeeble the male intellect, and on that ground alone the author appeals to the authorities to reconsider the regulations of female education.

LETTERS TO THE EDITOR.

The sun-thermometer during the recent eclipse.

AT mid-day, just before the commencement of the eclipse, Draper's self-recording sun-thermometer of this observatory indicated a sun-temperature of 92° F., while the self-recording thermometer in the shade at the same time indicated 33° F.

When the obscuration was at its maximum, 1.30 P.M., the sun-temperature had fallen to 69°, while that in the shade was still 33°.

At the end of the eclipse, 2.50 P.M., the sun-temperature had risen to 82°, and that in the shade to 34°.

It is interesting to note from the above facts, that one-half of the difference between the sun-temperature and that in the shade, at the beginning of the eclipse, is 29½°; while the actual fall of temperature during the eclipse, as shown by the sun-instrument, was 23°. This is as it should be, for only about one-third of the sun was obscured. It is probable, that, if the eclipse had been total, the readings of the two instruments would have been the same.

DANIEL DRAPER, Ph.D., *Director.*

New-York meteorological observatory,
Central Park.

An attempt to photograph the corona.

It occurred to the writer that the late partial solar eclipse would be an excellent chance to repeat Huggins's experiments on photographing the corona. A three-inch refractor of about forty inches focal length was employed. A drop-shutter was attached to the lens, giving an exposure which was estimated at about a fifth of a second. A piece of deep-violet glass was procured, which could be inserted just in front of the plate, or removed, at pleasure. By its use a negative image of the sun's disk was obtained, but without it the plate gave a reversed image; the sun being a positive and transparent, while the surroundings remained negative and were dark, the appearance being strikingly similar to that of a photograph of a total solar eclipse. Both bromide and chloride plates were provided; but, as with Mr. Huggins, the latter proved to give much the better coronal effects. A ferrous-oxalate developer was employed, which contained a large proportion of potassium bromide. The weather throughout the eclipse was wholly favorable; and we began photographing at ten o'clock, two hours and twenty minutes before the eclipse began, and continued at work until five minutes past four, or an hour and ten minutes after it had terminated. Photographs were taken every half-hour, with extra ones interpolated at the more interesting phases, making twenty-nine pictures in all.

Very corona-like effects were certainly produced, faint rays here and there shooting out perpendicularly to the sun's surface. But unfortunately no two of the pictures were alike, and the corona in front of the moon was quite as well marked as that on the other side of the sun. Indeed, the most corona-like ray produced, appeared in one photograph stretching directly towards, and terminating at, the centre of the moon. Nine photographs taken in succession showed one side of the halo stretching to a greater distance than the other; but in one of these the darkening was carried so far out, that it became nearly separated from the rest of the corona, and appeared as a distinct dark circle of the same size as, and by the side of, the image of the sun. This, of course, showed it to be merely an internal reflection of that image, and nothing more. During the course of the experiments, the object-glass was revolved about its optical axis, photographs being taken in four positions. No effect, however, was discernible upon the plates.

The conclusions I should draw from my experiment are, 1°, that, though it is very easy to obtain a corona-like image, one may readily be deceived in such matters, and the same effect be obtained by our atmosphere, without the aid of the solar corona, combined with little defects in the gelatine film (this, I think, is conclusively shown by the extension of the pseudo-corona in front of the moon); 2°, that chloride

plates are more suitable than bromide for obtaining an atmospheric corona, just as Mr. Huggins has claimed that they are more suitable for taking a solar one; hence I think one must not rely too much on the ultra-violet region sensitiveness of the chloride plate for a separation of the two; lastly, though my experiments fail to corroborate Mr. Huggins's results, they do not, of course, show that his corona may not be solar, but merely indicate that under very favorable circumstances I could obtain no trace of it.

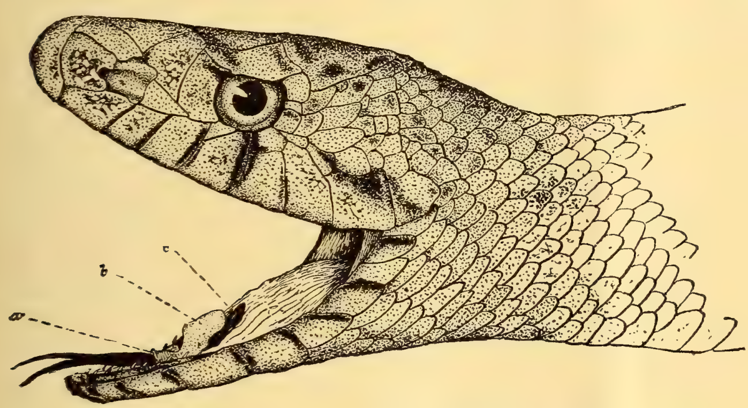
I have before me a print made from a negative by Dr. O. Lobse in October, 1878, showing effects very similar to those obtained by myself, except that his view was not taken during an eclipse. He considers that the halo is wholly atmospheric, and not coronal.

W. H. Pickering.

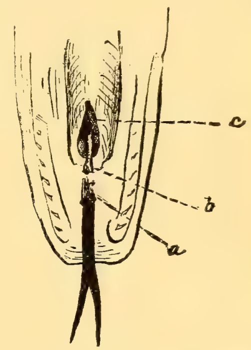
Photographic laboratory, Mass. inst. technology.

The voice of serpents.

The interesting observations presented by Prof. C. H. Hitchcock on this subject, in No. 104, and the additional experiments made by Mr. H. H. Nicholson upon a specimen of Pituophis Sayi. and recorded in No. 109, open a very interesting field for research.



LEFT LATERAL VIEW OF THE HEAD OF PITUOPHIS SAYI BELLONA, LIFE-SIZE.



THE MOUTH PARTS FROM ABOVE.

a, tongue-sheath; *b*, epiglottis; *c*, rima-glotidis.

(From *American naturalist.*)

If it has not already met your correspondents' eyes, it may not come amiss for me to invite their attention to a very interesting and important article relating to this subject, contributed by Dr. C. A. White to the January number of the *American naturalist* for 1883. Dr. White here very concisely describes the peculiar structure of the vocal organs of Pituophis, which, so far as I am aware, he is the first to have noticed.

The character of the voice of the bull-snake is well known; and Dr. White clearly shows in his article how the peculiar form of the epiglottis contributes to its production.

It may not be out of place to reproduce the drawings here, that I was permitted to make for Dr. White, illustrating this structure of the epiglottis in Pituophis. They may be of interest to those who have the opportunities of seeing the pages of *Science*, where the *Naturalist* may not be available.

In again calling attention to this structure and its situation, it may induce others to make further investigations into a very inviting subject.

R. W. Shufeldt, U.S.A.

Fort Wingate, N.Mex., March 19.

The Indians are the mound-builders.

In No. 108 of *Science* there is a review of 'Prehistoric America,' — a work by the Marquis de Nadaillac, — and at the end of the review an editorial note which has challenged my attention. You say that the review "seems to maintain the identity of all peoples that ever inhabited the American continent up to the advent of Europeans," and base this upon the opinions of the reviewer, that the mound-builders were no other than the Indian tribes found in the country in post-Columbian time, and their ancestors. In this respect I most heartily agree with the opinions of your reviewer. There has never been presented one item of evidence that the mound-builders were a people of culture superior to that of the tribes that inhabited the valley of the Mississippi a hundred years ago. The evidence is complete that these tribes have built mounds within the historic period; and no mounds or earthworks have been discovered superior in structure or contents to those known to have been built in historic times. The theory that the country was inhabited by a people highly organized as nations, and having arts of a higher grade than those belonging to tribal society, is wild and baseless; and the fruit of that theory is nothing but exaggeration and false statement.

All this being granted, your own conclusion, which is not found in the statements of the reviewer, is altogether inadmissible. "The identity of all peoples that ever inhabited the American continent, up to the advent of Europeans," is not and can not be held by any intelligent anthropologist, except in some very broad sense; as, for example, that they belonged to the human race, or that they occupied one continent. In respect to mythologies, languages, and institutions, there are, and have been, many distinct peoples; and in respect to arts there is much diversity, though arts travel from people to people with the greatest ease. At the present time we cannot have fewer than seventy distinct peoples among the tribes of North America, and in antiquity the number may have been greater. The mound-building peoples did not constitute a distinct race. Many peoples have built mounds on this continent, and some continue to build mounds to the present day. The writer has seen a tribe of Indians erect a mound.

J. W. Powell.

Washington, March 24.

THE RELATIONS OF MICROBES TO LIFE.

Owing to the fact that some microscopic organisms have been shown to play an important part in many forms of disease, we are somewhat in the habit of looking upon such organisms in general as our enemies, forgetting many useful purposes which they serve. One of the most important processes taking place on the surface of the globe is the destruction of such organic masses as have been the seat of life, but which have suffered death. We have only to think for a moment what the result of a stopping of this destructive process would be, in order to gain a vivid impression in regard to its importance. The living thing can resist the destructive forces. When life ceases, the resisting-power is gone; and, however complex the materials may be of which the organism is made up, they are quickly converted into simple and stable substances. The chief products of the changes are carbon dioxide, water and ammonia, all of which are of high importance, as from them again, under the influence of life, are elaborated the complex materials. Now, we know, that, in the breaking-down of organic matter after death, microscopic organisms play a principal *rôle*. They are the efficient scavengers of the earth. They effect the transfer of the oxygen of the air to the substances to be destroyed, and thus convert useless organic matter into that which is useful.

We thus see, that, while there are microbes which cause disease, there are others constantly at work keeping the conditions favorable to life. Recently the suggestion has been made, and by no less an authority than Pasteur, that the changes which are involved in the life-process of both plants and animals are probably intimately associated with the activity of what may be called life-microbes. Pasteur read before the Academy of sciences a paper by Duclaux, in which some experiments upon the growth of plants in sterilized soils are described. Duclaux's paper begins thus: "The destruction of the organic matter of the soil by microbes, and the production of a new vegetation on the soil, are two phenomena which always accompany one another. Is there any necessary connection between them? Through the labors of Pasteur, we know that microscopic beings can only live at the expense of complex materials elaborated by the plant with the aid of chlorophyl. Can the plant develop in the absence of microscopic beings? in other words, can it, without their aid, utilize the organic matter left by the plant which preceded it on the soil?"

With the object of attempting to answer this question, Duclaux experimented upon peas and beans. These were freed from germs, sown in a soil which was free from germs, and supplied with organic matter of a kind which one would naturally expect to be easily assimilated. The result was, that after one or two months the organic matter was found to be unchanged, and the plants did not thrive any better than when placed in distilled water.

Pasteur, in commenting on these experiments, takes occasion to suggest to Duclaux an experiment on the *rôle* which microbes play in animal life. The experiment is this. A hen's egg, from the surface of which all germs have been removed, is to be hatched in a sterilized space, fed with sterilized food, and supplied with sterilized air. Pasteur believes that the result will be that the chick will not live, and, in general, that life is impossible without the co-operation of microbes.

We must bear in mind that this is merely a suggestion, and that it rests at present upon no experimental evidence. Experiments of the kind suggested will involve great labor and the greatest accuracy. It cannot be denied, that, whether the results should prove favorable or unfavorable to the view of Pasteur, they would be of the highest interest to the chemist and biologist.

THE CLIMATE OF THE EGYPTIAN SUDAN.

In so vast a region of country as the Egyptian Sudan, extending as it does over about sixteen or eighteen degrees of latitude and as many of longitude, with differences of alti-

tude of more than six thousand feet on single parallels, it is evident that there must be great diversity of climate, a full discussion of which would occupy too much space for a reasonable article. But that portion of the Egyptian Sudan which at this time attracts the attention of the world by reason of the presence there of European troops, and the apparently intended operations of those troops, can be here concisely considered.

British troops now occupy two positions in the Egyptian Sudan; viz., the province of Dongola on the Nile, and the city and port of Suakin on the coast of the Red Sea.

Italian troops occupy the port and vicinity of Massowah, on the Red-Sea coast; and the Bay of Assab and its vicinity, on the same coast, near the strait of Bab-el-Mandeb.

Whatever may be the object of the Italian government in thus occupying positions on the Red-Sea coast, the object of the present British occupation is declared to be war against El Mahdi, and it will be necessary to consider the climate of the territories occupied by his forces.

El Mahdi now occupies and rules over the following: the province of Khartum, the province of Darfur, the province of Kordofan, the province of Senaar, the province of Berber, the district of Gallabat, the province of Taka (excepting the capital, Kassala), and the great desert region between the Nile near Berber, and the Red-Sea coast near Suakin and Agig.

Thus we have to consider the climate in the provinces and districts above named; and first the province of Dongola, now occupied by the expeditionary corps under Gen. Lord Wolseley, of probably about nine thousand British troops.

This is one of the rich and productive provinces of the Egyptian Sudan, extending from near Wady Halfa on the north, to the borders of the province of Berber along the course of the Nile. The correspondence from Lord Wolseley's corps has, during the past few months, made almost every hamlet and village throughout its length known to all parts of the world where newspapers are read. The climate of the region now occupied by the British force is not only good, but very agreeable, during four months of the year, — November, December, January, and February, — though February sometimes gives specimen days of the Khamseen wind which are very trying, even to natives of the country. During the months of March, April, May, and the first half of June, however, the climate, though not *very* unhealthy, is exceeding trying to all excepting natives of the country. The ordinary temperature is very high during the day; the thermometer in the shade often indicating from 95° to 110° F., while during the night the temperature falls to 65° or 70°. This great difference makes it necessary to take great care to preserve health; and, with the best of care, intermittent fevers are exceedingly prevalent. These, if neglected, are liable to take typhoid forms. During these months, the dust-storms coming from the southward are of most distressing frequency and violence. While these storms are hard to endure, and cause great suffering, I believe they to a certain extent destroy fever-germs, and prevent the climate from being so fatal to Europeans as it would otherwise be. From June to September the southerly and south-westerly winds come charged with moisture, though rarely yielding rain; and, while relieved from the dust-storms, the European is more subject to fever influences.

Such is the climate in which the British troops are apparently to wait during the next five months, before advancing against their human enemy. Should they wait there, under the best possible care and with the best possible medical surveillance, the commander will be fortunate should the 'unseen enemy' not reduce his force by more than ten per cent before October next, while another ten per cent would be so debilitated by repeated fever-attacks as to require a month of cool weather to restore their strength, and make them fit for a vigorous campaign.

The climate of Suakin can hardly be considered unhealthy, but for the excessive heat which reigns there, except during the three months of December, January, and February. There the desert comes down to the very sea-beach; and the air of the desert, though burning hot, is not unwholesome. But the heat in that region, where sometimes during two or three successive years rain does not fall, while the tropical sunbeams constantly bathe the rocks and sands, is of an intensity not to be conceived by those who have never experienced the like; and exposure to it by Europeans, without extraordinary precautions, is certain to produce sunstroke and congestions. The thermometer in April, in the shade, will often indicate a temperature of 100° to 105° F.; but even this does not indicate the effect upon a foot-soldier, who, marching in the sun, receives the direct rays, and, in addition, suffers from the heat radiated and reflected from the light-colored soil. It is, however, quite different with the *mounted* soldier, whether on horse-back or on camel-back; as, if well covered, he

GENERAL VIEW OF THE ASTRONOMICAL STATION AT CAROLINE ISLAND.

suffers less from the direct rays of the sun, and not at all from the reflected and radiated heat. As the entire route from Suakin to Berber is subject to heats fully equal to those of the vicinity of Suakin, it may be safely asserted that it is impracticable for European foot-soldiers to make the march between those two points during the spring and summer months, except by using the night and early morning exclusively for marching.

The climate of the province of Berber is very similar to that of Dongola; but, owing to the effects of the waters of the river Atbara, in some parts of this province fevers are more prevalent during the summer months, and of a worse type than in Dongola.

In the province of Taka and the district of Gallabat, the climate from June to October is deadly for Europeans. During that season the rains are there copious, and, mingling with the floods of water coming down from the mountains of Abyssinia, cause the rich soil to become like a saturated sponge, while the rank vegetation and the exhalations from the soil render the air poisonous. From many districts the natives abandon the country in May, taking with them their families, their flocks and their herds,— to save themselves and their families from fever; and their flocks and herds from the ravages of the stinging insects which, during the season of rains, infest the country. These people go north to the deserts, and remain until the latter part of October, when they return, to find their own country delightful in climate, and glorious in vegetation. These conditions remain through the winter, and the air is healthful until April.

The climate of Khartum is hot, damp, and exceedingly unhealthy from April until October. The winter climate is not disagreeable; but even in winter the place can hardly be considered healthy, owing to the peculiar location of the town between the Blue and White Niles, and to lack of sanitary rule in the construction of the streets and houses. During the past twenty years, more care has been taken in the construction of dwellings; and the conditions are now more favorable than they formerly were.

The province of Kordofan is visited by less rain than that of Khartum or of Taka. During the winter, from the last of October until the 1st of March, the climate is very agreeable and quite healthy. The prevailing winds are from the north. The temperature is not high, ranging in the middle of the day from 80° to 88° F. The air is bracing and invigorating, while the nights are cool and pleasant.

March, April, and May are there the hottest and most disagreeable season, though not unhealthy. In June the season of rains commences, and it lasts until the latter part of September or early October. The winds are then from the south and south-west. The rains come in showers, sometimes daily, but oftener once in three or four days. The air is debilitating; and fevers, intermittent in form, strike all, excepting the natives.

No matter what care may be taken to guard troops from the effects of climate, the death-rate among soldiers is always great during this wet season. In an expedition which I sent into that province, well organized, well and very carefully commanded, well supplied, with good medical attendance and good hospital supplies, six per cent of the soldiers died during four months of the season of rains, while during the remainder of the year there were very few deaths.

The climate of Darfur closely resembles that of Kordofan. The rains come at the same time of year, and the sanitary effects of the different seasons are nearly the same; yet the fevers, according to the reports of the medical officers, seem to be more often severe in type in Darfur than in Kordofan. C. P. Stone.

THE CAROLINE ISLAND ECLIPSE EXPEDITION.

The protracted duration of totality of the eclipse of May, 1883, early attracted the attention of astronomers; but an examination of its shadow-track on the earth showed the unfortunate fact that it would begin in the Pacific just east of Australia, and completely traverse the ocean, finally leaving the earth before the South American continent was reached. Only one eclipse had ever been observed with a greater duration of totality; and the possibility that an observing-station might be available in the small islands of the South Pacific determined Mr. Charles H. Rockwell of Tarrytown, N.Y., to endeavor to organize an observing expedition from the United States. Through his representations, the National academy of sciences was brought to consider the matter, and it was expected that Professor Young of Princeton would have the entire charge of the expedition. Unforeseen circumstances prevented this, and the party was finally organized with Professor Holden as chief, and sci-

Report of the eclipse expedition to Caroline Island, May, 1883. In vol. ii. of the Memoirs of the national academy of sciences. Washington, 1884. 146 p., 22 pl. 4°.

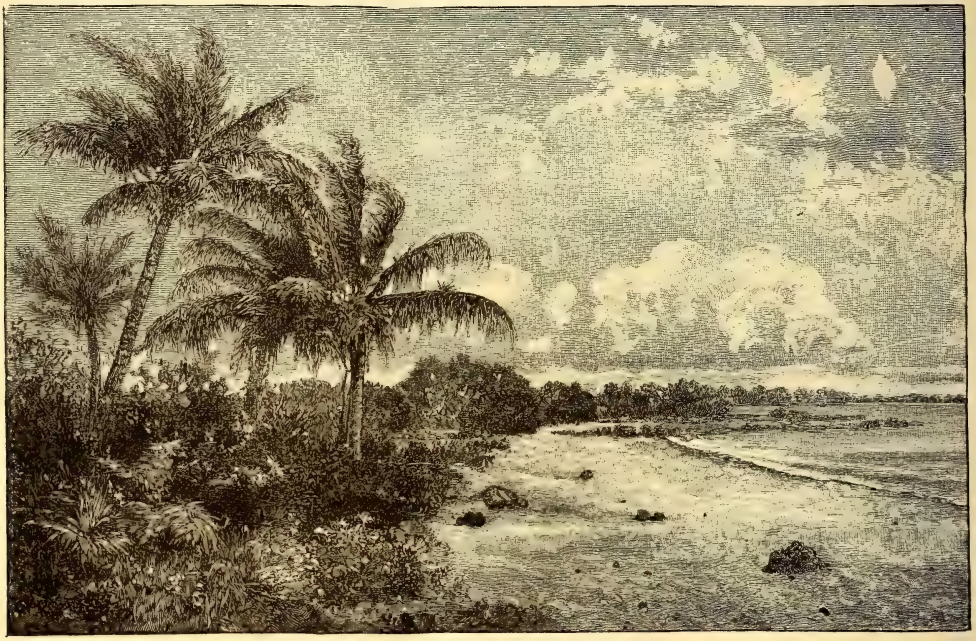
entific director. Pretty full accounts of the expedition, its objects, methods, and results, have already been published in *Science*, vol. i., at pp. 299 and 594, and vol. ii. p. 237.

Some idea of the magnitude of the undertaking may be gained when it is known, that, in addition to the elaborate home preparations of the instruments and apparatus for specialized investigations, the observers were absent from the United States more than three months, during the most of which they were travelling (some fifteen thousand miles, in all), and that ten full weeks were passed at sea.

They were expected to take up their abode somewhere on a small group of islands, about which nothing of importance could be ascertained beforehand, save the bare fact of their existence at a known spot in mid-ocean. The whole undertaking, however, was accomplished without a mishap of any kind occurring to interfere with the success of the work.

On the morning of the eclipse there were three rain-showers, and several persistent banks of clouds. The critical moments of totality, however, were passed with an unclouded sky; and the observations of the parties were successful, owing to the apparent accident of the dissipation of a local cloud.

So little was known of Caroline Island, that Professor Holden and the members of his party wisely devoted themselves to the study of the island in every particular; and their researches, although secondary to the main purpose of the expedition, have quite as much of interest as, if they are not of equal importance with, the results pertaining purely to the eclipse. First, Professor Holden gives us the history of the island; from which we learn that it was first seen in 1795, that it was once known as Thornton Island, and that in 1868 Capt. Nares, R.N., took possession of it for the British. Ten years later guano was exported from the island, — an item of interest when connected with the fact, that, in seeking for the deposits, the former owners of the island came upon native *marais*, or burial-places, numbering altogether fifty, in which they found stone axes and relics of various sorts.



THE BEACH OF THE LAGOON AT CAROLINE ISLAND.

The island, as it was in 1883, is well described by Professor Holden and Lieut. Qualtrough, the former quoting from Dana's 'Coral and coral islands,' and Darwin's 'Voyage of the Beagle,' their accounts of typical coral atolls. By supplementing these descriptions with the statement that Caroline Island is in general a pear-shaped ring of islets encircling a lagoon, the characteristic features of the islands become perfectly understood. A few facts from Lieut. Qualtrough's paper will be of interest: that there are, in all, twenty-five islets, well

covered with trees and shrubbery; that tidal observations in the lagoon show no relation between the rise and fall inside the lagoon, and outside; that the weather, though mostly fine, is somewhat changeable, with occasional sudden showers; and that the climate of the island, though warm, is delightful, the surrounding sea conducing to an equable temperature.

Mr. Upton presents a very full paper, occupying nearly one-third of the volume, on the meteorology of the island during the period of two weeks extending from April 25 to May 9. Frequent observations were made with the ordinary meteorological instruments, and with special radiation apparatus furnished by the chief signal-officer. The meteorological bearings of the eclipse were carefully attended to, and the observations are fully discussed, and the results clearly presented in graphical form.

One section of the report was prepared by Professor Trelease, and relates to the botany of Caroline Island as represented by the collections of Dr. Dixon, U. S. navy, who contributes also a page or two of interesting notes on the zoölogy of the island. The lepidoptera received attention, and the valuable collection made by Dr. Palisa was taken to Vienna for identification. At Professor Holden's request, however, he very kindly made and presented to the American expedition as complete a collection of duplicates as was possible; and these are reported upon by Mr. Butler of the British museum, and Mr. Strecker of Pennsylvania.

Coming now to the physical and astronomical results of the expedition, we find first a condensed statement of Professor Holden's plan of operations on the day of the eclipse, followed by the reports of all the observers on the special fields of work assigned to them. During the period of totality, Professor Holden devoted his own attention to the search for intra-mercurial planets, with the negative result long since known, and which he regards as conclusive to such an extent that "at future eclipses it will not be necessary to devote an observer and a telescope to the further prosecution of this search." Dr. Hastings, with an unusual equipment for polariscopic and spectroscopic work, gave his entire time to the solar corona. He found that with delicate methods the brighter portions of the corona ought to be observable more than a minute before totality. Dr. Hastings presents his own observations, and concludes that "the enormous change in the extent to which the 1474 line could be traced east and west of the sun, with very slight change of the moon's place, precludes the explanation hitherto accepted of a gaseous atmosphere extending as far as implied by the spectroscope." Regarding these results, then, as strongly indicating the need of a different explanation of the observed phenomena, he institutes a thorough review of the results of all the observations of the corona at previous eclipses, and groups them under the head of spectroscopic analysis, polarization, and photography. The hitherto accepted explanation of the phenomena is then briefly set forth; and following it his own explanation is proposed, which is, that the coronal phenomena may be fully accounted for by applying the well-known principles of diffraction to the sunlight which grazes the edge of the lunar disk, and is propagated to the eye of the observer.

THE PHYSICAL FEATURES OF BRAZIL.[1]

THE greater part of the empire consists of an elevated plateau, having the mean elevation of from 300 to 1,000 metres, limited on the north and west by the great continental depressions of the Amazonas and Paraguay basins, which are almost united through the valley of the Madeira, and its tributary the Guaporé. A portion of the elevated plateau of Guiana, nearly the whole of the great Amazonian depression, and the upper part of that of the Paraguay, are also included in the empire. In addition to these four grand natural physical divisions, there is also an Atlantic border-region, forming a narrow strip between the ocean and the eastern margin of the great continental plateau.

Although generally represented as wholly mountainous, the Brazilian plateau consists in great part of tablelands, which, from the deep excavation of the innumerable river-valleys, have become very much accidented, so as to present a mountainous aspect. The true mountains (restricting the term to the elevations formed by upheaved strata) are mainly in the eastern and central portions, and may be considered as constituting two groups, nearly separated by the elevated tablelands of the Paraná and São Francisco basins.

The eastern or maritime group accompanies the coast of the Atlantic at a short distance from the sea, from near the north-east shoulder of the continent at Cape São Roque, to or near the southern limits of the empire. The central or Goyaz group occupies a part of the southern portion of the province of Goyaz, and that part of the province of Minas Geraes lying to the west of the São Francisco, and is joined to the eastern group by a transverse ridge extending in the direction east-west, across the southern portion of the province of Minas Geraes. This transverse ridge, with the mountains of Goyaz, forms part of the great east and west watershed of the con-

[1] From the Rio *News*.

tinent, which is generally known as the Serra das Vertentes, — an improper designation, since a considerable portion of the watershed is not, properly speaking, mountainous.

The mountains of the eastern group form a long and comparatively narrow zone of about sixty miles in maximum width in the provinces south of Rio de Janeiro, which widens to four or five times that width in the southern part of the province of Minas Geraes, but becomes reduced to a width of from 150 to 200 miles in the region to the east of the São Francisco. In the provinces of Paraná, São Paulo, Rio de Janeiro, Espirito-Santo, and the south-eastern part of the province of Minas Geraes, where this group attains its greatest development, there are two well-defined parallel ranges, the Serra do Mar and the Serra da Mantiqueira, which extend from south-west to north-east. The culminating points are the peaks of the Organ Mountains, in the Serra do Mar, at the head of Rio Bay, 2,232 metres high; and Itatiaia, in the

RIVERS.

A. Amazonas.
B. Paraguay.
C. Paraná.
D. Uruguay.
E. Sao Francisco.
F. Parnahyba.
a. Tocantins.
b. Araguaya.
c. Xingú.
d. Tapajox.
e. Madeira.
f. Guaporé.
g. Purús.
h. Juruá.
i. Javary.
j. Negro.
k. Branco.
l. Jequitinhonha.
m. Doce.
n. Parahyba.
o. Rio Grande.
p. Tietê.
q. Paranapanema.
r. Iguassú.

PROVINCES.

I. Amazonas.
II. Pará.
III. Maranhao.
IV. Piauhy.
V. Ceara.
VI. Rio Grande do Norte.
VII. Parahyba.
VIII. Pernambuco.
IX. Alagoas.
X. Sergipe.
XI. Bahia.
XII. Esprito Santo.
XIII. Rio de Janeiro.
XIV. Sao Paulo.
XV. Paraná.
XVI. Santa Catharina.
XVII. Rio Grande do Sul.
XVIII. Minas Geraes.
XIX. Goyaz.
XX. Matto Grosso.

Serra da Mantiqueira, at the angle of the three provinces of Rio de Janeiro, São Paulo, and Minas Geraes, with 2,712 metres of elevation above the level of the sea; this last being the highest point of the empire. Somewhat to the north of Rio de Janeiro the culminating line of the group passes from the Serra da Mantiqueira, which continues in a north-easterly direction, to a branch, which, under the name of Serra do Espinhaço, extends north, or a little east of north, along the eastern margin of the São Francisco basin. The highest points of this range are the peaks of Itacolumi (1,752 metres) and Caraça (1,955 metres), near Ouro Preto; the peak of Piedade, near Sabará (1,783 metres); and Itambé, near Diamantina (1,823 metres). The mountains of this group become lower in the provinces north and south of those above indicated, and to the northward of the São Francisco are represented by short detached ranges and isolated peaks.

The western mountain group consists of at least two distinct ranges, — that of the Serra da Canastra, or Matta da Corda, extending in a general northerly direction from the head waters of the São Francisco to the southern rim of the basin of its great western tributary the Paracatú; and the mountains of southern Goyaz, extending in a north-easterly direction between the heads of the Tocantins, Araguaya, and Paraná basins. The first is an offset from a broad expansion of the Mantiqueira Range, which, in southern Minas Geraes and northern São Paulo, extends westward to, and somewhat beyond, the head of the São Francisco. Its culminating point is the Serra da Canastra, at the source of the São Francisco, which rises 1,282 metres above the sea. The limits and extension of the Goyaz chain cannot be definitely traced, as the accounts of the geology of the region are too meagre to enable one to discriminate between the true mountains of upheaval and the ridges produced by denudation from horizontal strata. It is thus impossible, at present, to state how great a part of the various watersheds radiating from the Goyaz Mountains as a centre should be classed with them, or whether any of these ridges constitute, or not, a distinct system. The culminating point of the system is the Montes Pyreneos, near the city of Goyaz, whose height is variously estimated at from 2,310 to 2,932 metres, the former being probably nearest the truth.

The great tablelands (composed of horizontal or

nearly horizontal strata) of the Brazilian plateau are those of the Paraná, Amazonas, São Francisco, and Parnahyba basins. That of the Paraná basin, which may be considered as embracing the Uruguay, includes a large portion of the provinces of Rio Grande do Sul, Santa Catharina, Paraná, and São Paulo; a small part of south-western Minas Geraes and southern Goyaz; and the elevated portion of the province of Matto Grosso, and of the republic of Paraguay, lying between the Paraná and Paraguay. The maximum elevation along the eastern border in the provinces of Paraná and São Paulo is approximately 1,000 metres, the general level becoming a few hundred metres lower to the southward and westward, as the result not only of denudation, but also of a general lowering of the surface.

The Amazonian tableland includes the greater part of the provinces of Matto Grosso and Goyaz, a large part of southern Pará, and relatively small portions of south-eastern Amazonas and western Maranhão. It is drained by the Tocantins-Araguaya, Xingú, Tapajós, and lower Madeira, with its tributary the Guaporé, all of which descend from the tableland in a series of rapids, at a distance of from 100 to 200 miles from the Amazonas. The southern margin of this great tableland — an escarpment rising to between 800 and 1,000 metres above the level of the sea, and facing the depression of the Paraguay and Guaporé — has received the name of Serra dos Parecis.

The São Francisco tableland lies mainly to the west of that river, in the western part of the provinces of Minas Geraes and Bahia, and rises to the height of about 800 metres. It is doubtful whether or not it extends over the watershed, so as to be continuous with those of the Tocantins and Parnahyba valleys. The latter occupies all, or nearly all, of the province of Piauhy, and a portion of southern Maranhão and western Ceará, and is perhaps continuous with the Amazonian tableland along the Tocantins divide.

All of these tablelands are deeply cut by numerous river-valleys so as to present almost everywhere a mountainous aspect; and the ridges formed by denudation are generally spoken of as mountains, and are represented as such on all maps of the empire.

The Brazilian portion of the Guiana plateau is very imperfectly known. Along the watershed between the Amazonas and the rivers flowing to the Caribbean Sea there are mountains whose culminating points are said to rise to the elevation of 2,000 metres or more; and spurs of high lands extend to within a few miles of the Amazonas at several points between the mouth of the Rio Negro and the sea. This region is drained by the Rio Negro, with its tributary the Rio Branco, and a number of smaller rivers, among which the Jamundá, Trombetas, Parú, Jary, and Araguary are the most important.

The great Amazonian depression is relatively narrow along the lower river, below the mouth of the Rio Negro, the average width being probably between 100 and 200 miles. Above the Rio Negro and Madeira, in the province of Amazonas, it widens considerably, so that it presents a bottle or flask shape. The river is generally bordered by low alluvial plains, often of considerable width, which are subject to overflow, and are full of lakes and anastomosing side-channels of the great river, or of the lower courses of its tributaries. The higher lands are either tablelands less than 300 metres in height, formed by deposits peculiar to the depression, or denuded outliers of the margins of the great continental plateaus on either side, or of the Andean plateau at the head of the basin.

The Brazilian part of the Paraguay depression is the upper portion of the immense plains of the basin of that river, which form a large part of the Argentine Republic, Paraguay, and eastern Bolivia. These plains lie several hundred metres lower than the lands of the plateau that encircle them, and of its numerous spurs and outliers. They are, for the most part, but slightly elevated above the level of the rivers (the upper Paraguay and its tributaries) that traverse them, and, during the wet season, become transformed into immense lakes and marshes.

The Atlantic border-region consists of a zone, generally only a few miles in width, lying between the coast and the margin of the continental plateau. South of Rio de Janeiro it is constituted by low sand-plains full of lagoons, and by denuded spurs and outliers of the plateau. North of Rio de Janeiro there are in many places, in addition to these, hills and tablelands of formations peculiar to this coast-belt, which rise to a height of from 100 to 200 metres.

O. A. Derby.

THE LAST CRUISE OF THE ALBATROSS IN THE GULF OF MEXICO.

According to a late report by Lieut.-Commander Z. L. Tanner, U.S.N., commanding the U. S. fish-commission steamer Albatross, dated at New Orleans, Feb. 13, the recent short cruise of that vessel has been productive of some interesting results.

The Albatross left Washington on the afternoon of the day before Christmas (1884), and after some delay by ice in the river, and by rough weather in Chesapeake Bay, arrived at Norfolk on the morning of the 26th. Having taken in coal at Norfolk, and received the party of naturalists detailed for the cruise,[1] she put to sea on the afternoon of Jan. 3 (1885), bound for Key West. At starting, the very unusually high barometer of 31.10 was noted; but the glass began falling early next morning, with the setting-in of a smart south-east gale and heavy sea. On the 6th, the weather having moderated, a trawl-line was set for tile-fish, in 79 fathoms, off the Carolina coast, but without result. Four hauls with the beam-trawl, with wing-nets and mud-bags, in about the same locality, were more productive, bringing up many familiar species, and some new to the ship.

[1] Mr. J. E. Benedict (in charge), Capt. J. W. Collins, Dr. Tarleton H. Bean, and Mr. Thomas Lee.

A sharp gale from the southward, and heavy sea, now set in, preventing further work; and, after waiting two days for the weather to moderate, the Albatross proceeded on her way, taking several king-fish with trolling-lines as she passed along the Florida reefs. Having taken in coal at Key West, she sailed on the 15th for Havana, where she arrived the next day. Notwithstanding the rough and uneven bottom, several hauls were made with the beam-trawl in 37 fathoms, on the afternoon of the 15th, with excellent results. The next five days were occupied in daily trips out of Havana, and the constant use of the tangles and beam-trawl upon the 'Pentacrinus' ground. Thirty-two hauls, in all, were made, bringing up a large supply of sea-lilies, besides an immense variety of other things, and one specimen of sea-lily supposed to represent a new genus.

Leaving Havana on the 20th, the surface tow-net was put over on two successive evenings just after dark, with poor results, there being very little surface life. On the 21st two hauls (beam-trawl) were made in 426 and 423 fathoms, north of the western end of Cuba, with fair results, notwithstanding coral patches on the bottom. Two wrecks, one a Spanish man-of-war, were seen on Colorado reefs. On the 22d sent down tangles, and afterward small beam-trawl, in 167 fathoms, off the eastern end of Arrowsmith Banks, with excellent results, including many forms unknown to those on board.

After a week spent in studying the fauna of Cozumel Island, off the east coast of Yucatan, the Albatross, on the 29th, visited the south-west end of the island; and, while the gunning and seining parties went ashore, the ship stood off shore, and took two hauls each with the trawl and with tangles in from 137 to 231 fathoms. The tangles brought up many forms new to the party, but the trawls were not successful. Having picked up the shore parties, the ship stood away for the Campeache Banks, and made seven hauls with the beam-trawl, getting many forms new to those on board, besides using the tangles and hand-lines. It had been intended to remain here for several days; but the occurrence of a case of typhoid-fever on board made it desirable to get the sick man into hospital as soon as possible, and Pensacola was headed for as the nearest. There coal was taken aboard, the sick man landed, and the ship sailed again, Feb. 5, to explore the banks off Cape San Blas. On the way out from Pensacola, the three-masted schooner, Fanny Whitman, of Rockland, Me., was discovered ashore in a dangerous position, with distress-signals flying. She was towed off and set afloat; and on the 7th, fishing-lines, tangles, and trawls were put over on the banks (27 fathoms) with satisfactory results. Red groupers were found with ovaries distended, but none fully ripe. Returning to Pensacola on the 9th, the ship sailed again for New Orleans on the 10th, taking soundings every five miles from latitude 29° 27′ north, longitude 87° 44′ west, in a south-south-west direction, to latitude 25° 54′ north, longitude 88° 2′ west (698 fathoms), and running other lines in various directions, east and west, without finding any bank or shoal, and generally confirming the soundings of the coast-survey chart. Three hauls of the beam-trawl, bringing up many specimens unknown to those on board, were made about latitude 29° 10′ north, longitude 88° 15′ west. This locality was found to be so promising, that it will be revisited hereafter.

After running another line of soundings in the direction of New Orleans, the Albatross came to anchor off Algiers on the morning of the 13th of February.

TECHNICAL INSTRUCTION IN AMERICA.

ROYAL commissioners were appointed in England on Aug. 25, 1882, "to inquire into the instruction of the industrial classes of certain foreign countries in technical and other subjects," and "into the influence of such instruction on manufacturing and other industries at home and abroad." A thin octavo report issued in 1882, and a very voluminous report issued in 1884, contain the results of the investigations of the commission. In vol. ii. of the second report is contained the report on technical education in Canada and the United States, compiled by Mr. William Mather of Salford, Eng., a well-known manufacturer, who has indicated his enthusiasm for technical instruction by the establishment of a well-equipped school for apprentices employed at his works.

Mr. Mather arrived in New York on May 23, 1883, and, after a six-months' tour through the states and the British possessions, returned to England on Nov. 1, in the same year. Special inquiries were made by him upon the subject of technical and industrial education in twenty-two different cities, including San Francisco, Richmond, and the most important intervening cities. Not less than one hundred educational institutions and manufacturing establishments were visited, but reports were made only upon the typical institutions visited. Mr. Mather has divided the results of his inquiries into four parts: —

1°. A general view of the public schools in cities and counties, and a description of the scientific training in the colleges and universities in the various states.

2°. The technical, industrial, and manual training-schools and art-schools.

3°. The effect of these institutions on the industries of the country, through the intelligence of the proprietors, foremen, and work-people.

4°. The influences and institutions, other than schools, tending to the advancement and improvement of the industrial population.

There is also an appendix to the report, containing statistical information, letters from prominent educators, and abstracts of methods of instruction in different places.

Second report of the royal commissioners on technical instruction. Vol. ii. No. 2. Report on technical education in the United States of America and Canada. By WILLIAM MATHER. London, *Eyre & Spottiswoode*, 1884.

A very favorable account is given of the attendance at the schools, the subjects taught, and the methods of administration. The prevalence of illiteracy in certain sections is noted. Attention is called to certain phases of the labor question; in particular, strikes, trades-unions, machinery, wages, and prices. Several pages of the report are devoted to the technical and art schools of Canada.

The most interesting portions of the report are parts ii. and iii., relating to the colleges and institutions devoted to art, science, and technical instruction. Special attention is called to Columbia college, the Cooper union, Workingman's school (Adler's), Steven's institute, Cornell university, Massachusetts institute of technology, Sheffield scientific school, Worcester free school, St. Louis manual training-school, University of California, Girard college, Maryland institute, Johns Hopkins university, Harvard college, Hampton normal institute, and other art and science institutions. The methods of instruction, the plan of government, the resources and special features of each institution, are critically noted; but only that phase of the instruction given which pertains directly or indirectly to technical education is emphasized. Very little space is devoted to the handicraft schools in which the industrial education is made an end, and not a means to foster intellectual development. The definiteness of aim, and the practical character of the instruction given, in the schools of technology, are commended in high terms. The ambition of the student is sustained by a reasonable expectation of entering upon a useful career at the close of his scholastic labors. The employment of manual labor as a part of intellectual training is favorably commented upon. Mr. Mather quotes a familiar expression of employers of labor: 'Our brightest boys come from the country.' Not that he would disparage the mental grasp and acumen of the city-bred boys; but the habit of using a great variety of tools fits the farmer's boy to profit by the instruction given in the workshops and laboratories of polytechnic schools. Professor Brewer's recent lecture on the educational value of the farm may be here cited in confirmation of Mr. Mather's views.

As one example of the great interest taken in technical instruction by a wealthy community, mention is made of the generous endowment of a hundred thousand dollars received by the training-school of Chicago from the 'Commercial club' of that city, — an organization composed of eminent business-men. The munificent gift of Mr. Peter Cooper of New York, resulting in the erection of the 'Cooper union,' is specially noted. The St. Louis manual training-school of the Washington university is commended for its wise adaptation of manual labor to mental culture. The progress made in industrial, decorative, and the fine arts, is regarded as very gratifying.

It is somewhat unfortunate that Mr. Mather did not have time to inspect the results of the industrial art education given by Mr. Leland in the public schools of Philadelphia. The very favorable notices already received by Mr. Leland from European educators leads the writer to believe that a close analysis of his methods by such a well qualified observer as Mr. Mather would have thrown much light upon this phase of the industrial movement in America.

Close attention was paid to the workshop-schools erected by certain great railroad corporations to educate apprentices for responsible positions in the service of the roads. The Altoona shops of the Pennsylvania railroad are cited, where a high grade of technical instruction is given to employees as a means of securing to the company 'an unbroken succession of officers.'

No comment, however, is made upon the efforts being made in several sections to introduce technical instruction into the public schools. But this phase of the industrial education movement is so recent, that it has hardly advanced beyond the domain of theory. At least three methods have been advocated by well-known educators, in regard to manual training in public schools: viz., 1°, that specific trades should be taught as a part of the present system; 2°, that manual instruction should be limited to a general use of certain tools and machines; 3°, that public workshops should be erected to teach only manual training. Mr. Mather, however, noted the difficulty experienced by boys in securing places in machine-shops, on account of their ignorance of tools and machines; and he suggests that practical instruction in this direction would be very helpful to many boys in our large cities.

Not a single institution was heard of in America, by our Manchester visitor, which aimed to give training in the textile industries. In all manufactures which involve the knowledge of the qualities of fibre, and the process of working raw material, the only safe reliance is upon skilled foreigners. No investigations were made upon the mechanical industries of the southern states; but the enormous resources of this entire section, and the possibility of educating its people to rely upon their own skill and invention, must soon attract attention to the subject of technical and industrial education in that region.

Mr. Mather is of the opinion that the technical schools of America have already accomplished great results; but their high fees often tend to exclude the artisan class. Evidences of the good influences of these schools are indeed discernible in almost all the large shops and manufactories; but the advantages have been reaped almost entirely by the employers and their managers. It is vitally important that the ordinary journeyman should share the advantages of technical training. The importance of schools of pure science is pointed out, and much gratification is expressed at the important scientific discoveries already made in some of the foremost educational institutions. No one can predict, says Mr. Mather, to what practical purposes a new scientific principle may be employed.

The special report on technical education in America was indorsed in most favorable terms by the royal commissioners, and is commended to educators as deserving of most careful perusal.

CHINESE IRON-FOUNDRIES AND RICE-PAN CASTING.

As a notable example of the patient plodding industry shown by the Chinese, may be instanced the manufacture of the very thin cast-iron ricepans which may be seen in any cook-house in Hong-Kong. The principal seats of this industry are at the towns of Sam-tiu-chuk and Fatshan. The iron used is obtained by smelting magnetic oxide. The ore is broken up and smelted with charcoal in a very primitive smelting-furnace some eight feet high. The cupola is cone-shaped, having its apex at the bottom. The single tuyere pipe is of earthenware, the opening for the emission of the blast being inclined downwards. The furnace itself is of earthenware, strengthened by hoops and longitudinal straps of iron. The whole is lined with clay several inches thick. The internal diameter at the bottom is about two feet, and at the top three feet and a half; the inside depth being about six feet. The blast is produced by a rude bellows, formed of a wooden box five feet long, by three in horizontal, and a foot and a half in vertical section. This box is divided longitudinally into two compartments, each eighteen inches square in vertical section. In each of these compartments a piston works, the valves being so arranged that one piston is effective in the up, and the other in the down or return stroke. As there is no air-chamber, the blast is not perfectly continuous. The fuel used is charcoal; and the furnace, being first heated by starting a fire with fuel alone, is then filled up with alternate layers of charcoal and ore in small fragments. The blast is urged, and, after a sufficient time has elapsed, the molten metal is drawn off from a tap-hole at the bottom, and cast into ingots. These, when intended for export, are afterwards reheated in an open forge.

For making the very thin ricepans, which are cast without handles, pure iron of native manufacture alone is used. The moulds in which the pans are cast require weeks of tedious and patient labor to bring them to perfection. They are composed of two parts, an upper and a lower, and are made of carefully puddled clay. The great secret of the process which enables the Chinese founders to cast their iron pans of such large diameter, yet so thin and light as to be scarcely thicker than a sheet of paper, appears to be the use of highly heated moulds and pure charcoal pig-iron. When the ovens and their contents have cooled down, which takes about two days, the luting attaching the upper portion of the mould to the lower is carefully removed, and, the moulds being separated, the pan can be extracted. When the operation is successful, the same mould can be used several times. The pans now have each attached to its bottom a lump of iron, which, from the extreme brittleness of the pans, requires the greatest care in its removal. These runners are carefully sawn off, and the edges smoothed down; the pan is then ready for the export market. Handles are attached to these pans by the retail dealers.

From the *Journal of the iron and steel institute.*

The pans made at Fatshan differ from the preceding in being cast with handles attached near the rim to the inner surface of the pan, which necessitates the breaking of the mould at each casting. They are usually cast much thicker and heavier than those of Sam-tiu-chuk, and occasionally one-third of foreign pig-iron is mixed with the native iron for casting. In other respects the process followed at both places is the same.

GREAT ANTIQUITY OF THE AMERICAN RACES.

In an article in the *Zeitschrift für ethnologie*, on the great antiquity of the human races, Dr. Kollmann takes American material to test his theory that the craniological varieties of mankind existed in quaternary times as they are found to-day. For this purpose, accepting the geological evidence of their antiquity as conclusive, he brings together observations and measurements upon crania from California, Illinois, Patagonia, central Brazil, and Buenos Aires. The first will be recognized immediately as the celebrated Calaveras skull. To the original measurements of Dr. Wyman, the author adds his own measurements taken upon Whitney's plate ('Auriferous gravels of California'), using for a term of comparison the heads of six Indians who visited Basle in 1882. He finds the Calaveras skull does not resemble European, but Indian crania in specific race-characters, which have persisted since the glacial epoch. The less familiar cranium from Illinois, known as the McConnel skull, was found enveloped in drift material in a cleft in a rock-bluff. It is now owned by Dr. Schmidt of Berlin, whose measurements are incorporated in the text with his conclusion, from a comparison of this skull with those in the collections at Washington and Philadelphia, that it is not unlike more recent long skulls from Illinois.

The rest of the study is based on material from South America. On the banks of the Rio Negro, Patagonia, in a stratum similar to that of the quaternary loess of the pampas, Moreno found two skulls which seem to him identical with existing forms. At the last Congrès des Americanistes, 1883, Lütken invited the attention of craniologists to the as yet unmeasured material representing the remains of thirty individuals, which Lund obtained in the cave of Sumidouro, near Lagoa Santa, Brazil. In a recent visit to Copenhagen, Dr. Kollmann measured four of the best preserved male crania, which, like one given by Lund to a Brazilian collection, and measured by Lacerda and Peixoto, are long, with broad faces. According to the latter authorities, they resemble the heads of Botocudos. The last of the group is one taken by Roth from the upper pampas formation of northern Buenos Aires. To Virchow, who took its measurements upon photographs, it recalled involuntarily the brachycephalic, prognathic skulls of Sambaquis. Nehring also stated to the Anthropological society of Berlin, that he has in his possession a Sambaqui skull from Santos, which presents a real resemblance to this.

Assuming, as he does, that these crania are all pre-glacial, and finding among them both long and short skulls, Dr. Kollmann arrives inevitably at the conclusion that already in pre-glacial times the men of America had cranial and facial forms widely differentiated into varieties which have persisted until the present time, in spite of lapse of time, and change of environment. The persistence of type leads him further to question the probability of an alteration of race-characters from change of environment, or the possibility of the development of another, more perfect race.

A KINDERGARTEN SYSTEM OF CHEMISTRY.

It appears to be a law, that, whenever a hypothesis of fundamental importance is introduced into a science, it is utilized for all sorts of purposes for which it was never intended. This is certainly true of the valence hypothesis in chemistry. The conception that the smallest particles or atoms of the elements differ from each other in regard to the number of other atoms with which they can enter into combination, is the result of a profound consideration of the facts of chemistry, and its significance can be comprehended only by those who have made a deep study of these facts. The valence hypothesis is utterly meaningless to those who do not know considerable about chemical substances and their action upon each other. Notwithstanding this, the mere mechanical considerations involved in it are so simple, and can be so readily illustrated, that we find incompetent teachers thrusting them upon the attention of beginners even before any sort of notion has been conveyed in regard to the nature of chemical action, or of the distinction between elementary and compound bodies. We need only pick up any one of the small text-books in common use, and, ten chances to one, we shall find an example of the kind of treatment referred to.

It would be difficult, however, to find any thing to equal "The chemists' and students' assistant, or, Kindergarten system of chemistry," which has recently been brought to our attention. The author or inventor of this system evidently thinks that the essential things in chemistry are not compounds, but formulas; that, if one can manipulate formulas with sufficient skill, he knows chemistry. Now, in order to deal with the formulas, it is not at all necessary to know any thing about the compounds represented. A very few simple principles, which a child can thoroughly comprehend, are alone required. We are therefore at last in a position to study chemistry without any reference to chemical phenomena. The odor of chlorine and of sulphuretted hydrogen, the activity of oxygen, the conduct of acids towards bases, need no longer be known to the student of chemistry. Laboratories for instruction are superfluous. All we need is 'The chemists' assistant.' This wonderful thing consists of a box containing a number of blocks of different shapes. The simplest blocks, which represent the simplest atoms, have but one angle: others have two, three, four, five, or six angles, and represent respectively the bivalent, trivalent, quadrivalent, etc., elements. A collection of such blocks by itself is not a very harmful thing, and we can conceive of the blocks being used in connection with a course of instruction in chemistry without leading to an entirely false notion concerning the things represented. Their use, however, would require the greatest care, as they would be more likely to do harm than good. When we read the author's explanatory words, we first recognize the enormity of the system with which he has presented us. After stating in general terms how the blocks are to be used, he says, "For lectures or class illustrations, this system will be exceedingly useful; for the illustrations on the charts and blackboard will address the eye as well as the mind of the student, and consequently will lead to a quicker conception of the subject lectured upon.

"As this system is identical with that of the kindergarten, the young students will be charmed with the various forms which can be made by the elements, some of which are exhibited in the following illustrations."

We then find some illustrations of chemical reactions which certainly do charm the eye of even the old student. The first one represents what takes place when water acts upon calcium oxide. Oxygen, with its two points, joins two single-pointed hydrogen blocks, and we have water. Calcium (two-pointed) fits close to oxygen (also two-pointed), and we have lime. The change to the hydrate, or, as common people call it, slaked lime, is too abrupt: we therefore have an intermediate stage represented. This is called the 'cracked-up' stage, though, from the general appearance of the formulas, we are inclined to think that it might better be called the 'exploded' stage. Finally order is restored, and we have a peaceful, symmetrical-looking group, which, we are glad to be told, is 'calcic hydrate.' The idea of including in chemical equations the intermediate 'cracked-up' stage, is, we believe, original

The chemists' and students' assistant; or, Kindergarten system of chemistry. By William Farmer. New York, *Author*, 1884.

with the author. It cannot fail to fascinate the youthful student in the kindergarten. It has long been maintained that the elements of some of the sciences might be taught with advantage in the kindergarten. It remained for the inventor of this system to show how readily this may be done. The expense is a mere trifle, and no preparation on the part of the teacher is required. We shall soon find our children making marsh-gas, or 'ethene dibromide,' or showing how nitrate of potassium and sulphuric acid are converted into nitric acid and hydric potassic sulphate; we shall hear them making the fine distinction between plain water and cracked-up water; and we shall be obliged to confess that the method by which we were taught the elements of chemistry was a very cumbersome one as compared with the simple method of Mr. Farmer.

While fully recognizing the humorous features in the kindergarten system of chemistry, we cannot avoid a feeling of depression when we regard it as evidence of a state of mind which is very prevalent. Too many teachers of chemistry, like Mr. Farmer, magnify the importance of formulas, and lose sight of the facts which they represent. This is the crying evil in chemical instruction at the present time. The teacher who 'knows the theory,' but doesn't 'know the practical side of the subject,' is still abroad in the land.

FONTAINE'S OLDER MESOZOIC FLORA OF VIRGINIA.

This work is one of the smallest of this series; but it is one of merit and importance. Although the number of fossil plants from Virginia strata here enumerated is not great, they are so thoroughly illustrated, and so critically discussed, that their diagnostic value is fully brought out. Professor Fontaine may fairly claim to have demonstrated, from evidence furnished by the plants alone, that these older mesozöic beds, which had not previously been clearly distinguished from the younger ones, and had been commonly grouped with the latter as the trias of Virginia, can scarcely extend so low as the extreme upper trias, and conform more closely to the rhaetic of Franconia, Bayreuth, and Palsjö, or even to the lias of Rajmahal.

This conclusion, of course, is derived from an analysis of the species discovered, and a study of their affinities with species obtained from strata in other parts of the world, whose geological position is fixed with some degree of accuracy. This subject is discussed at length. The substance of it can be given in a few words.

The whole number of distinct plants described is forty-five. Eight of these were already known from other localities under established names; four more of this class are referred to different genera or species: making twelve not confined to Virginia. Of the remaining thirty-three which are so confined, nine have close affinities with species already described. It thus appears that considerably over half of the entire number are peculiar to the locality, and have no weight in determining its horizon. The decision must therefore turn entirely upon the twenty-one species which are either themselves found outside of Virginia, or are nearly allied to such as are so found.

The author has made some errors in his table of distribution, such as the omission of Schizoneura planicostata, which he describes in the text, and the failure to assign Ctenophyllum Braunianum to its proper horizon (rhaetic). These corrections made, we find that while only one of the species (Asterocarpus platyrachis) has its nearest affinity with an exclusively triassic plant, and only seven have their nearest affinities with exclusively Jurassic plants, there are ten which have either been found in the rhaetic only, or are most closely allied to such as have only been so found. Thus thirteen species, or about five-eighths, may be classed as rhaetic plants; and only four, or less than one-fifth, can at best be set down as triassic. The seven Jurassic species are mostly from the lias, or lower oölite, which, while not negativing the rhaetic character of the Virginia beds, does seem, when coupled with the rest of the evidence, to negative their triassic character.

We have not space to go further into details, and will merely add, that, while our analysis of his facts differs slightly from that made by Professor Fontaine, the conclusion which flows from it is the same; viz., that in so far as fossil plants can be depended upon to correlate the deposits of different parts of the world, those of the Richmond coal-fields point to the rhaetic of Europe as the age to which they must be referred.

It is something to have even thus far fixed the geological position of this hitherto unsettled formation; but those who are specially interested in the progress which is taking place

Contributions to the knowledge of the older mesozoic flora of Virginia. By William Morris Fontaine. Washington, *Government*, 1883. 12 + 144 p., 54 pl. Monographs of the U. S. geological survey, vi.

in vegetable paleontology will perhaps regard as still more important the discovery and careful characterization of the twenty-eight forms which the author describes as wholly new to science, twenty-six of which receive the rank of species, and for the satisfactory classification of which he has found himself obliged to create the two new extinct genera, Mertensides and Pseudodanaeopsis. Of these twenty-six new species, eight are allied more or less closely to known forms, leaving eighteen species so distinct that the author has been unable to compare them with any thing that has been hitherto described. This is remarkable, in view of the great uniformity which is generally found to exist in the floras of the earlier geological formations at points the most widely separated geographically. It seems to indicate an unexpected divergence of the mesozoic flora of North America from that of Europe and other districts of the eastern hemisphere.

An important feature of the work, not indicated by its title, is a careful revision by Professor Fontaine of the researches in the same line of Dr. Ebenezer Emmons in North Carolina, made some thirty years ago, and published in part vi. of his 'American geology,' 1857. The fossil plants found by Dr. Emmons, and figured in this work, are described under the head of 'Fossils of the trias;' but Professor Fontaine thinks he has conclusively shown, from a study of his figures and descriptions (the fossils themselves having been destroyed during the war), that this 'trias' of Emmons in North Carolina is identical with his 'older mesozoic' of Virginia.

The work is copiously illustrated, there being, in all, fifty-four plates, the last six or seven of which are devoted to the reproduction of the figures of Emmons. The photo-engraving process is employed, and we have here a standard from which to judge of its applicability to the illustration of fossil plants. In some respects it proves quite satisfactory; at least, when we consider its cheapness, and the advantage it thus furnishes of allowing, at moderate cost, the ample illustration of species, which is so great a necessity in this branch of paleontology. But we do not think the most has been made of the process in the present work.

The index, which is otherwise good, contains one feature which cannot be too highly commended to authors of such works. This is the reference to plate and figure, as well as to page; which, in more than half the cases, saves the reader the labor of looking twice.

ANNALS OF THE NAVAL OBSERVATORY.

During the period covered by the observations contained in these two volumes, the naval observatory was under the superintendency of the late Rear-Admiral Rodgers. His general reports to the chief of the Bureau of navigation, on the work of the institution, were promptly issued in the latter part of the years to which they refer, and are reprinted, as customarily, in the annual volumes.

Pursuant to its policy, inaugurated some five years ago, of reducing the size of its bulky publications, — a policy which has met with universal commendation, — the observatory might now go farther, and expunge a good fraction of the protracted and annually reiterated introduction to the observations with the transit-circle. We seriously question whether disastrous ambiguity would ensue if we were not told, with every year, that the ridge of the roof covering the transit-circle extends east and west; and that the hole in the cube of the axis of the instrument is 2.3 inches in diameter; — to say nothing of the continued reprint of formulae and details of reduction, which every astronomer, who has occasion to consult the volume, keeps constantly in mind. This introduction now occupies about one-fourth of the entire volume, including observations with all the instruments of the establishment, and the several appendixes. We suspect, however, that the only sufficient remedy lies, not in excerption, but in rewriting *ab initio*, on the supposition that those who will read the introduction already know something.

The newly adopted form in which the observations with the transit-circle are published seems to have been very carefully studied, and is in every way a model. We should like to be able to write as strongly of the precision of the results of stellar and planetary observations with this instrument, the character of which is too well known to require characterization here. Presumably, no one is responsible for the fact that they are not better; but certainly the frequent change of observers, unavoidable in so far as the observatory itself is concerned, is not conducive to results of a high order of accuracy.

During the years 1879 and 1880, the transit-circle was under the charge of Professor Eastman, and was employed with customary

Astronomical and meteorological observations made during the years 1879 *and* 1880 *at the U. S. naval observatory.* 2 vols. Washington, *Government,* 1883–84.

regularity in observing the stars of the 'American ephemeris,' the sun, moon, and planets, and lists of miscellaneous objects chiefly used by exploration parties and expeditions in determining latitudes. In the choice of dates when observations of the bodies of the solar system, particularly the outer great planets, were made, no systematized plan of operation appears to have been followed. It would be well if the adaptation of the observations to the problems of the future investigator were kept in mind equally prominently with the fact that these bodies, a month or two preceding the opposition-time, transit the meridian at inconvenient hours beyond midnight. The days of observation should be so chosen that it will be possible to derive a series of normal places for each planet symmetrically placed with reference to the epoch of least distance from the earth.

The great equatorial, with Professors Hall and Holden as observers, was mainly occupied with work upon double stars; but the satellites of the outer planets were fully observed, as also the great nebula of Orion, the observations on which were published by Professor Holden several years ago, in his well-known monograph.

There is no record of observations with either the prime vertical transit, the mural circle, or the east transit instrument; and there is very little to show for the lesser equatorial of the observatory. The meteorological observations have been conducted on about the same plan for a long series of years, having been begun long before the Army signal-service was in successful operation as a meteorological bureau. If they are continued on the supposition that they form a valuable addition to meteorology, this would appear to be an insufficient reason; while, for any known practical bearing on astronomy, they are barely worth the making and printing.

The volume of observations for the year 1879 concludes with two appendixes, the latter of which is a determination of the semi-diameter of the moon from occultations of the Pleiades, by Mr. H. M. Paul; and the former, by Professor Hall, on the parallax of α Lyrae and 61 Cygni. In the appendix to the volume for 1880, Mr. Winlock has so collected all the observations and drawings of the great comet of 1882, made at the naval observatory, as to make them available, in considerable part, for definitive discussion of the comet's orbit.

While, on looking casually through these volumes, one is impressed with the necessity of bestowing greater care on the details of proof-reading, it is a pleasure to note the sudden influx of new types in the printer's fonts from which the latter part of the volume for 1880 was set, replacing the old types, which had become so much worn as to make scores of figures on many pages quite indecipherable.

With the commencement of the present year, the observatory, under the superintendency of Rear-Admiral Franklin, has begun the execution of a pre-organized plan of astronomical work. This has already been printed and distributed, and the advantages to be expected from this arrangement will be watched for with much interest.

BRAIN-EXHAUSTION.

THIS book belongs to a class which finds circulation only in this country, and is not calculated to establish a foreign reputation for the author. If the time spent upon its preparation had been given to accurate observation or careful experiment, and the results condensed into an article of twenty pages, the author might have secured some attention. The work consists of a mass of theoretical statements regarding normal and abnormal brain-action, few of which have any basis in ascertained facts. We know that brain-exhaustion is possible, and we know under what conditions it occurs. The chapter on causation contains a fair summary of these conditions. We do not know the mechanism of its occurrence, and we cannot affirm, in a given case, that a definite line of treatment will succeed.

The author has a favorite method which it is the object of the book to urge. The method does not commend itself to those who are familiar with recent German investigations by experiment, which, as far as animals go, are directly opposed in their results to the conclusions reached by Dr. Corning. Electrical treatment of brain-disease must be conducted with caution, and only with the aid of an accurate galvanometer which measures the intensity of the current, and enables the physician to know at any moment what strength he is using. Of this, as well as of other necessary precautions, Dr. Corning seems unaware, for he recommends the use of from 'five to fifteen cells,' a wholly unknown quantity.

Science demands facts, not theories; and the sooner this is understood by those who seek a place in its ranks, the better.

Brain-exhaustion, with some preliminary considerations on cerebral dynamics. By J. L. CORNING, M.D. New York, *Appleton*, 1884. 234 p. 16°.

NOTES AND NEWS.

It is announced that the next meeting of the American association for the advancement of science will be held on Aug. 26 and following days, at Ann Arbor, Mich. The vote of the association at the Philadelphia meeting was to hold the 1885 meeting at Bar Harbor, Mount Desert Island, Me., provided suitable accommodations could be secured; but, failing that, the meeting would be held at Ann Arbor. The decision was left to the permanent secretary. The correspondence of this officer has developed the fact that it would be quite impossible to hold the meeting at Bar Harbor in August, as the hotels would be overcrowded. It would only be possible in July or in the latter part of September. The decision to meet at Ann Arbor was also re-enforced by the invitations which have been received from the mayor of that city, and the president of the University of Michigan, cordially urging the association to decide to visit that place; and, as the meeting will fall in vacation, there will be ample accommodations, as fifteen hundred students and four hundred members of professors' families are cared for in term-time. The university offers to open its halls for the sectional meetings. There is no doubt that the association will thoroughly approve the decision of the permanent secretary.

— Mr. J. A. Allen, who for many years has had charge of mammals and birds at the Museum of comparative zoölogy at Cambridge, has accepted the curatorship of mammalogy and ornithology in the American museum of natural history in New York, where he will enter upon his new duties about May 1.

— The friends of rational work in physiology have achieved well-merited success in the university of Oxford. Early in March, in an overflowing 'convocation,' says *Nature*, the battle of vivisection was fought out a third time. The victory of sound sense over false sentiment has again been won; and on this occasion the vote is unmistakable. In spite of the most vigorous exertions of the opponents of physiology, the decree to endow the physiological laboratory — as the other scientific departments in the university are endowed — has been carried by the large majority of one hundred and sixty-eight. The dean of Christchurch opened the debate in a moderate speech recommending the grant. He pointed out that the vote was for teaching-purposes, and in no way concerned vivisection; for Professor Burdon Sanderson had given the most complete assurances that he would not use painful experiments on living animals for the purposes of teaching. Canon Liddon opposed the decree, on the ground that the council should have introduced further safeguards against the indiscriminate use of vivisection. He admitted that vivisection was justified in certain cases, and spoke of it as a painful necessity. The bishop of Oxford denied the moral right of man to inflict pain in order to advance knowledge, and declared vivisection to be degrading to the sensibility and humanity of the operator. The vote was supported by Professor Dicey and Sir W. Anson, and unintentionally damaged by Dr. Acland. The last speakers were much interrupted by a clamor which prevented their remarks being heard. The announcement of the result — *placets*, 412; *non-placets*, 244 — was received with great enthusiasm, both in the arena and in the undergraduates' gallery. It is to be hoped that this decisive vote will put an end to the warfare waged against the teaching of physiology in Oxford.

— In an article in the March number of the *North-American review*, on 'the moral aspects of vivisection,' treated solely from an ethical point of view, Prof. Noah K. Davis concludes that "whoever hinders the physiologist in his duties by exciting public odium, commits a trespass on him, and on society at large, in whose interest he is laboring, and so does a multiplied wrong."

— The journal of the English Society of arts, in speaking of the testing of house-drains by smoke in order to ascertain whether the joints are tight, describes the 'Innis' smoke-rocket,' which can be used in place of the iron vessel for fire, and the pump or fan for forcing the smoke into the drain, and which is found to be much more handy and simple. The rocket is made of a composition that will generate an abundance of smoke, packed in its case hard enough to burn ten minutes, thus giving time for the inspector to light it, introduce it into the drain, insert a plug behind it, walk through the house to inspect the joints, and finally reach the roof, where the smoke is issuing from the soil-pipe. A wet cloth thrown over the top of this pipe may be used to cause a slight pressure in the pipes below, and thus render the test more severe. Such a test would appear to be more satisfactory than the introduction of peppermint-oil, and to imitate the action of sewer-gas in attempting to pass the usual traps.

— The *Academy* announces the initial number of a journal entitled *Parallax*, and supposably intended to be published monthly. It is edited by Mr. John Hampden, the valiant champion of the theory that the earth is a circular plane. The *Academy* is disposed to welcome the new periodical, as the professedly comic papers have been painfully dull of late. Mr. Hampden retains all his well-known ingenuity of vituperative expression. To call Sir Isaac Newton 'a fanatical pantheist' is a happy thought which would certainly not have occurred to everybody.

— We learn from *Nature* that the trade in children within the province of Yakutsk is the subject of an interesting note in a recent number of the *Izviestiya*. The Irkutsk geographical society had received a note from one of its members, who thus depicted the lot of girls within the province: In the last century the poorest Yakute, who had no means of supporting a large family, took his new-born child in a covering of birch-bark, and hung it on a tree in the forest to die from hunger. But the richer Russian merchants began to buy children from their poorer Yakute clients, and so several Russians purchased whole families of servants. This custom induced the Yakute communities to take care of the poorest chil-

dren; and the community was bound to feed them under the name of *Kumolan* children, who spent three days in the houses of the richer members of the community, two days in those of the moderately wealthy, and one day with the poorest. But of late the custom has arisen of selling children, and especially girls, to Olekminsk merchants, who sell them further to the Yakutes and Tunguses of the Olekminsk district. The parents sell girls for from thirty to forty roubles (from three to four pounds); and in Olekmir they are re-sold for sixty roubles, sometimes eighty roubles. Of course, this trade is made under the cover of 'taking children to bring up.' The Irkutsk society having taken interest in this communication, it has received information from Yakutsk authorities, and from a well-known student of Yakute life, Mr. Gorokhoff. It appears from these communications that such trade really exists; the chief impulse to it being given less by the work a purchased girl might do than by the possibility of receiving for her the *kalym*, that is, the money paid by men for purchasing a wife. Woman labor is at so low a price that one might have a woman in his household and pay her half a piece of cotton, 'for a shirt,' per year. But the *kalym* reaches very high prices. One rich Yakute has recently sold his daughter to a Tungus for 3,000 reindeer, and the same price was recently given by a half-idiotic Yakute for the daughter of another Yakute. Middendorff quotes also several instances of a very high *kalym* paid for girls, its average being about 500 roubles. When a Russian priest sold a girl whom he had educated, for five sables and ten skins, it was considered as a very low price. Altogether, the *kalym* is the chief cause of maintaining the trade in girls, together with the gradual impoverishment of the Yakutes.

— The second part of this season's course of Saturday scientific lectures in Washington opened March 28, with the following programme: President J. C. Welling, Oldest history in the light of newest science; Mr. Frederick W. True, Ornithorhynchus, a mammal that lays eggs; Medical Director A. L. Gihon, U.S.N., Sanitary ignorance among high and low; Mr. J. S. Diller, A trip to Mount Shasta, California; Dr. D. E. Salmon, Our invisible enemies, the plagues of animal life; Prof. T. C. Mendenhall, Weighing the earth.

— Capt. L. U. Herendeen of San Francisco communicates the following notes on prehistoric structures in Micronesia. American missionaries recently settled at Ponapé, may, it is hoped, furnish additional details hereafter.

A few years ago I visited Ponapé Island in the Pacific, in east longitude 158° 22′, and north latitude 6° 50′. The island is surrounded by a reef, with a broad ship-channel between it and the island. At places in the reef there were natural breaks, that served as entrances to the harbors. In these ship-channels there were a number of islands, many of which were surrounded by a wall of stone five or six feet high; and on these islands there stood a great many low houses, built of the same kind of stone as the walls about them. These structures seem to have been used as temples and forts. The singular feature of these islands is that the walls are a foot or more below the water. When they were built, they were evidently above the water, and connected with the mainland; but they have gradually sunk until the sea has risen a foot or more around them. The natives on the island do not know when these works were built: it is so far back in the past, that they have even no tradition of the structures. Yet the works show signs of great skill, and certainly prove that whoever built them knew thoroughly how to transport and lift heavy blocks of stone. Up in the mountains of the island there is a quarry of the same kind of stone that was used in building the wall about the islands; and in that quarry to-day there are great blocks of stone that have been hewn out, ready for transportation. The natives have no tradition touching the quarry, — who hewed the stone, when it was done, or why the work ceased. They are in greater ignorance of the great phenomena that are going on about them than the white man who touches on their island for a few hours for water. There is no doubt in my mind that the island was once inhabited by an intelligent race of people, who built the temples and forts of heavy masonry on the high bluffs of the shore of the island, and that, as the land gradually subsided, these bluffs became islands. They stand to-day with a solid wall of stone around them, partly submerged in water.

— J. Borodin describes, in the journal of the Royal microscopical society, what he believes to be the long-sought pure chlorophyl. He obtains it in a crystalline form, by slow evaporation of an alcoholic solution, though he has not yet been able to isolate the crystals. They are doubly refractive, giving a beautiful green sheen in polarized light. Their physical properties differ from those of the dark-green crystals of hypochlorine hitherto obtained.

— American zoölogists will be interested to learn what is to become of the great collections in Central-American ornithology and entomology amassed by Messrs. Salvin and Godman. A recent note in *Nature* announces that a part of it is already given to the British museum, and that the rest is to follow. One collection, presented on certain conditions not specified by *Nature*, comprises the entire series of American birds brought together by those gentlemen, numbering upwards of twenty thousand specimens, and illustrating, more than any other collection in existence, the life-history and geographical distribution of the birds of tropical America. No labor or expense has been spared in the formation of this splendid group of ornithological rarities. The other gift, which is unconditional, comprises a very fine collection of Central-American Coleoptera of the families of Cicindelidae and Carabidae. It contains 969 species, and, moreover, 7,678 examples, of which more than four hundred are types of new species described in the work entitled 'Biologia Centrali Americana,' now in course of publication by Messrs. Salvin and Godman. To this collection will be ultimately added, by gift, the remaining families of Coleoptera, with other entomological specimens.

SCIENCE.

FRIDAY, APRIL 10, 1885.

COMMENT AND CRITICISM.

THE NOMINATION of Hon. Norman J. Coleman of Missouri to be commissioner of agriculture, if it is to be taken as the expression of a distinct policy on the part of the new administration, shows that no radical change in the status of the department of agriculture is to be looked for. The selection in itself is a commendable one. Mr. Coleman has for years been one of the prominent agriculturists of the Mississippi valley, and, so far as we know, is well fitted by his knowledge of practical agriculture, and his experience of men and affairs, for the position to which he has been nominated. We believe he will compare favorably with previous commissioners. But, whether Mr. Coleman be better or worse than his predecessors, the difference is in degree. We do not understand that he has, or claims to have, any special and intimate acquaintance with the science of agriculture, and we do not anticipate that under him the department will be essentially other than it has been. Its organization as a scientific bureau, with a technical expert at its head, as advocated in a recent number of *Science*, is apparently as remote as ever.

THE IMMEDIATE effect of a meeting of the American association for the advancement of science is a large increase in its membership, not only in the place which offers its hospitalities any given year, but also in the whole section of which the place is a centre. Thus the meeting in Philadelphia last year not only increased the membership in that city from 56 to 150, but spread its influence into the whole surrounding region; so that, whereas a year ago there were in Pennsylvania only 111 members, there are now 267, while the membership in New Jersey has also increased from 50 to 73, — a total increase in these two states of nearly the entire advance which was made in the list of membership of the association for the past year. It now numbers 2,347 members, against 2,011 last year. The membership in Philadelphia is thus at once raised to the first rank, in which only three cities may claim a higher place, — New York, with 171; Boston, with 161; and Washington, with 155 members.

How long this membership is retained in such places seems to depend largely upon circumstances. It may be noted, however, that in no place where the meeting has been held since the civil war, until the meeting in Boston (at which the membership was at once doubled), are there more than two cities — Chicago (1868, 30 members) and St. Louis (1878, 52 members) — where there are now more than twenty-five members. In four of them, indeed, there are less than ten, of which Dubuque (1872), with its single member, is the most striking example. With its great increase of membership, it is now, more than ever, plain that the association can only meet in cities of considerable size, unless it be in a university town, or in some far-off place where the expense of travel compels a small attendance. The falling-off of membership in the cities which have held the association since it grew to enormous proportions, has not been very large, at least during the past year, and offers great hope that a much more permanent interest in the association is secured by one of these meetings than could be expected. Thus Boston, where the association met in 1880, gained five members last year; Cincinnati lost nine; Montreal, four; while the membership at Minneapolis remained the same.

We have scanned the list with a view of finding out how largely membership in the association is influenced in smaller places by

such an interest in science as is indicated by the presence of local scientific societies strong enough to publish proceedings of some sort; and the result appears to be, that these societies are not, to any appreciable extent, feeders of the association. It is more probable that they are oftener its children. Thus San Francisco numbers but seven members; Denver, two only, losing one during the past year, which has witnessed the publication of a whole volume of proceedings from the local society; the great city of Chicago has but thirty members, even with an increase of four during the past year; Davenport, Io., has only two; Albany, with its long-established Albany institute, only fifteen, a loss of one during the year; Buffalo, with more than one society flourishing from time to time, eleven, a loss of one member during the year; Poughkeepsie, five, a loss of one; Troy, twelve, a gain of three; Wilkesbarre, six, a gain of four during the past year; Milwaukee, four, a gain of one; Toronto, twelve, a gain of one; and Halifax, N.S., a single member.

University and college towns are very generally represented, but, excepting at large centres, by only three or four members. How widely distributed the membership has become, is shown by the significant fact that no less than 597 places contribute to the list; indicating clearly that the assembling of five hundred or a thousand scattered members once a year, must be an important factor in the advance of science in this country, far more than it is possible it should become in such a country, for instance, as England.

AMONG RECENT naval orders, we note that of Rear-Admiral Franklin to the command of the European squadron. That this able officer, who has been superintendent of the observatory only about a year, should be so soon relieved of his duties and assigned to another station, will be a matter of regret to all those friends of the observatory who hold to the belief that its efficiency under an exclusively naval management is as great as it ever would be under any other.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The carnivorous habits of the Rodentia.

IN recent numbers of *Science* several observers have spoken of the habit possessed by the muskrat, Fiber zibethicus, of feeding upon certain mussels to be found at its places of resort. As already referred to by one of these contributors, instances were brought up before the Biological society of Washington, a few months ago, of their destroying for food-purposes carp in the carp-ponds. I wish to enter here but one additional charge against this animal, which has been the subject of so much abuse lately. Several years ago, when I lived in a town situated upon Long Island Sound, I saw upon a number of occasions, when collecting during moonlight nights, muskrats swimming along the stone wharves where the shipping moored. It never struck me, however, that they were in search of food, until I observed one, on one occasion, dive, and return in a moment to the surface with a fish in its mouth some five or six inches long. I killed the animal in the act, and secured both fish and rat. The former proved to be a specimen of Gadus tomcod, — a fish which in early winter swims sluggishly along close to the wharves in those latitudes, and one easily captured, I imagine, by such a good swimmer.

The muskrat, however, does not stand alone in this particular propensity among the Rodentia. While collecting near Fort Wingate, N. Mex., a few days ago, I was so fortunate as to capture alive a specimen of Hesperomys, of what species I am not positive as yet. This truly beautiful little animal was taken from its nest in a tree in the immediate vicinity of several lodges of Neotoma floridana. On arriving home, about nightfall, it was consigned to a wooden box in my study. My work-table in this room was covered with things familiar to those who are acquainted with the doings of a naturalist in the field. Among them was a vessel containing coarse cornmeal, used in skinning animals and birds. Near this lay fresh specimens of pine-linnets, blue crows, and several other birds, which I intended to convert into skeletons. My Hesperomys escaped during the night, and although he had been a prisoner but a few hours, and presumably not hungry, he ate nearly the entire body of one of my pine-linnets, never touching the saucer of cornmeal which stood immediately by it.

Next morning the contents of his stomach proved his guilt. The flesh-eating habits of rats are too well known to call for comment in this connection.

R. W. SHUFELDT.

Fort Wingate, N. Mex., March 20.

Mr. Melville's plan of reaching the north pole.

If you can spare the space in your journal, I would like to make a few concluding remarks on Dr Boas's criticism of my proposed route toward the north pole, and my theory thereon.

Dr. Boas, in his letter to *Science*, confines me to

the hard and fast line of 85° north latitude, where the ice-cap is supposed to be fixed by centrifugal and other forces, and insists on my saying I will have a smooth ice-cap to travel over to the pole; whereas, in both cases, *about* 85° north and a *comparatively* smooth ice-cap are intended.

"And in returning, he intends to use the southern drift of the ice," etc. I speak of, and lean upon, *probabilities* in my theory altogether; and the millions of square miles of ice that drift out of the Arctic Ocean do not come from near the pole. Capts. Nares and Markham, nor any one else, has ever seen a 'paleocrystic sea of ice.' All the ice ever witnessed by the eye of man has been 'broken floe' or drifting 'pack' of but one or two years' growth, or at most of but a few years' growth, that breaks up and drifts away from the outer edge of the ice-cap under discussion.

While drifting in the Jeannette, we observed a large 'old-time' floe piece (about sixteen miles area) that might have been of any age. It certainly was very much older than any surrounding ice; and it had the appearance of what might be termed a *piece* of the paleocrystic ice-cap near the pole, that had been broken off farther up into the upper 'fringes' of the cap, and had drifted away.

This floe piece has no reference to bergs that are made upon the land, and take ages to form, but to the ice of the salt sea. Hard as dolomite, and of the dead color of marble, it was entirely different from the pack and floe ice of 70° or 80° north latitude. This is one more reason why I believe, that, as we proceed toward the pole north of 85°, we should find the disputed ice-cap formed of this older ice.

Dr. Boas says, that, "if it can be proved that an ice-cap cannot exist, his [my] plan must needs fall to pieces. . . . No doubt the centrifugal pull at a certain parallel will be equal on every meridian," etc.

But the very mile of ice that Dr. Boas depends upon to pull the ice-cap from its place, and hurl it down toward the equator, is just the mile or miles of ice that break away from the ice-cap because of the weakness of the ice at the fringes; and, as it breaks away, the cap regains its equilibrium. Whether the strength of the ice at the pole will withstand the centrifugal force, tending to carry it toward the equator, will depend upon the velocity of that force, and the amount of hold and the number of holds the islands have upon the cap, as well as the contending currents and other forces that are continually at war with each other. And I do not concede that my argument referring to an equal pull (comparative and then equalized again) by the centrifugal force cannot be maintained.

Even though all my theories fall to the ground, I am doing just what Dr. Boas wants his readers to believe I am not doing; that is, I am not depending upon my theories alone for my scheme of advance toward the pole, but I am depending upon the lessons taught by 'former experiences,' and 'not on vague theories.'

I propose to go by way of Franz Josef Land, for the reasons that it is the northernmost land known on the face of the earth; it is readily accessible every year; retreat from this land is sure and safe. By this route alone are we enabled to hold to the land to the farthest point north, and I would not leave the land at all if it extends all the way to the pole.

But if it does not extend all the way to the pole, then I must take to the ice, over which I believe I will have easy travelling, compared to that south of 80°, where the motion is greater than toward the pole, and where most of the observations of the ice conditions have been made. All, all else is theory.

I have no desire to go to the Arctic to perish. It is my knowledge, founded on personal experience and that of others that I have studied intently, that makes me believe that I can go to the pole *via* Franz Josef Land with a greater degree of safety than by any other route, and *that it is the route of the future.*

I thank Dr. Boas for his courtesy and words of praise. I do not class him with the narrow-minded obstructionists of whom he speaks; but I cannot agree with his hair-splitting arguments, or his hard and fast lines of demarcation, in which he insists that my theories are based on erroneous data, or in opposition to the standard authorities of the day.

GEORGE W. MELVILLE,
Chief engineer U. S. navy.

Columnar structure in sub-aqueous clay.

During the summer of 1883, in the vicinity of Menomonee, Dunn county, Wis., I was fortunate enough to see, while it was still fresh, a deep railway cut through the sub-aqueous clays which overspread that region, reaching up to considerable altitudes above the Red Cedar River. The cut was something less than a hundred feet above the stream, and between twenty-five feet and thirty feet deep. Beneath the shallow soil was a stratum of distinctly laminated brown-yellow clay-loam about ten feet in thickness. Beneath this was a stratum of clay of a peculiar greenish hue, also distinctly laminated, and through which occasional sandy partings were traceable. This stratum was about five feet in thickness, and was followed, in descending order, by stratified sand, which extended to the bottom of the cut.

In the second clay stratum, reckoning from the top, columnar structure was beautifully developed. Not only was this structure conspicuous as seen in the nearly vertical face of the cut, but several of the hexagonal columns had individually separated from the others, and, after falling a number of feet from their natural position, still preserved their integrity as they lay at the bottom of the cut. The columns varied in diameter from ten to fifteen or sixteen inches. They were uniformly, but not regularly, six-sided, and could be divided easily across their longer axes, parallel to the bedding planes, so that each column was separable into regular sections. Whenever this parting was made (and the experiment was repeated several times), the opposing surfaces, after separation, were never plane, but always showed a greater or less curvature, convexity fitting concavity. If my memory serves me rightly, the convexity was at the lower end of each section, though, unfortunately, I find nothing in my notes on this point.

Another interesting feature was observable on the cross-section surfaces; viz., a distinctly concentric structure. This, in some cases, was very conspicuous; in others, to be discovered only on close inspection. In more than one case, the concentric lines, which were real structure-lines, and not merely lines of coloration, were almost continuous around the column, but they were more commonly somewhat interrupted. The concentric lines were generally very numerous, and therefore closely approximate, and more commonly best developed just about the centre, or else near the exterior of the column.

This structure would seem to be an additional confirmation of the hypothesis which ascribes columnar structure to concretionary action.

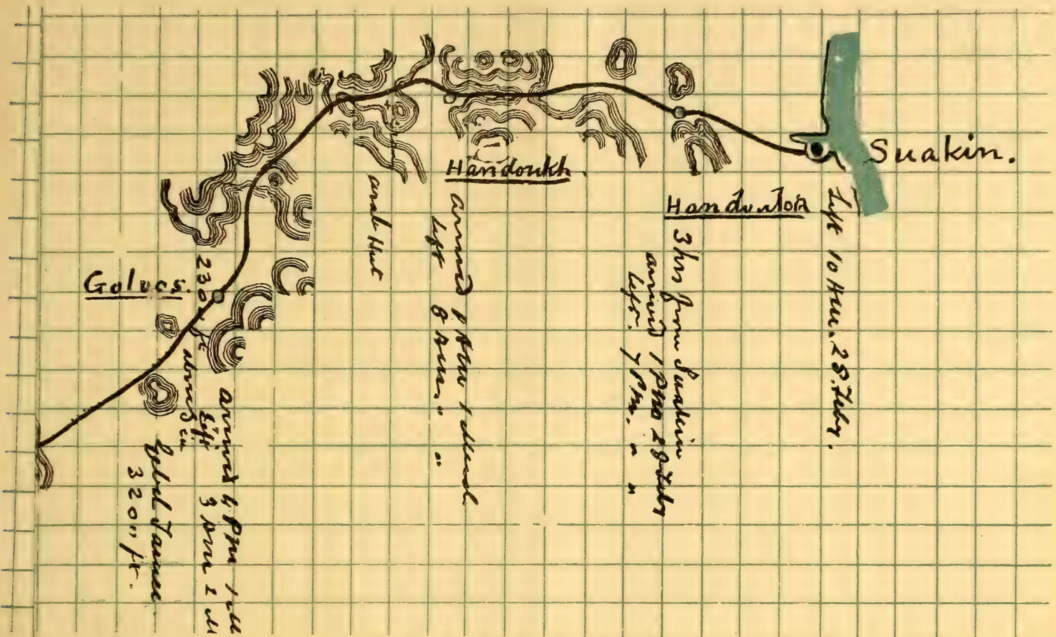
Beloit, Wis., March 25. R. D. SALISBURY.

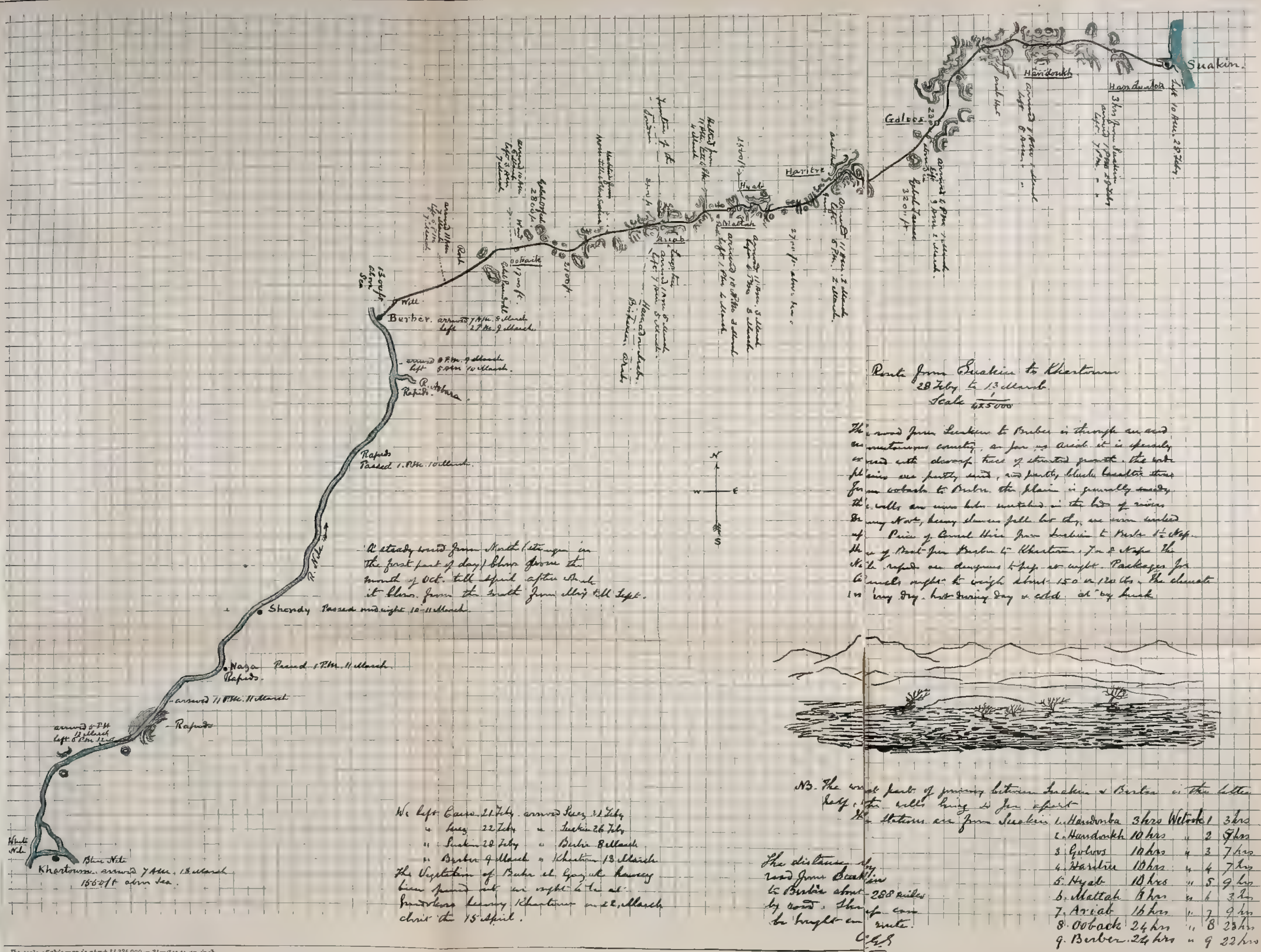
PERIPATETIC SCIENCE TEACHING.

A VERY interesting experiment is being tried in Birmingham, by way of showing with what good results science can be taught to quite young children by a teacher who goes from school to school, and has his apparatus carried around with him. There is something very amusing to an American — it would be hard to say exactly why — in the description given in *Nature* of a 'strong youth' dragging through the city his 'hand-cart' laden with apparatus, and, when he reaches a school, unpacking it, spreading it out on a table, and retiring at the moment the demonstrator steps in. But after enjoying the local color of the picture, it may be well to ask ourselves whether the plan is not a good one, and deserving of imitation in our own public schools. In this country, no form of science-teaching is introduced, as a general thing, below the high school. The Birmingham course is given to children of from ten to thirteen years of age. One lesson fortnightly, of about forty minutes' duration, is given in the fifth and higher standards in each school. Between the visits of the science-demonstrator, at least one lesson is given to the class by the teachers of each school (as a rule, by a teacher who was present at the demonstrator's lesson, and who took full notes of it), and a written examination in the subject-matter of the lesson is also held. Most of the apparatus is of the simplest form, and so made that it can be taken to pieces, and examined in detail, by the children. Much of it Mr. Harrison has himself designed and had made for the purpose. His plan is to prepare working-models, pictures, and diagrams of pumps, for instance; to have the apparatus arranged on the table; and to draw from the boys what they know about pumps before telling them any thing. He then shows them the working of the machine, explains its principle, and reminds them of other instances in which they have seen the same principle at work. Before he comes to them again, the regular teacher goes over the ground once more; and then the boys write out what they have learned, and make drawings of the objects from memory. Some of the papers which we have seen showed a remarkable degree of intelligent comprehension; and one of the most interesting cases in the education department of the London health exhibition was that which contained a set of mechanical apparatus made by the boys at home with no better tool than a jack-knife.

The course extends over three years. For the last year, the syllabus covers the mechanical powers, liquid pressure, the parallelogram of forces, and the parallelogram of velocities. The second year is devoted to food, and to the warming, cleaning, and ventilation of the dwelling. The topics discussed in the eighteen lectures of the first year are not those which we should expect to find in a course on mechanics. The second lecture, for instance, is devoted to the human body, its structure, and the use of the microscope: and on succeeding days are discussed oxygen, hydrogen, nitrogen, amyloids, albuminoids; the composition of milk, eggs, etc.; wool as a material for clothing; hard and soft water; the skin; and soap and soda.

There are two distinct features in the Birmingham plan whose merits need to be discussed separately, — teaching science by means of a single teacher and set of appliances for several schools, and teaching it to very young children. With regard to the latter question, we shall have something to say at another time; but, whatever one may think about teasing children ten years old with such hard things as amyloids and albuminoids, there is no doubt, that, if it is to be done at all, it can be done best by a peripatetic teacher. Good science-teachers do not grow on every bush; and, when one has been found, it is a pity not to use him with as great economy as possible. Few of the teachers now in grammar-schools have received any scientific instruction: still less have they been able to acquire the methods, which are far more important than the facts. The attempt to teach the teachers *en masse* would probably not be very successful. There are comparatively few grown people who can go back to the child's delight in asking


Suakin.
Handoukh.
Handuntoia
Golucs.
3200 ft.



FACSIMILE OF A MAP DRAWN BY GENERAL GORDON, OF HIS ROUTE, IN 1874, FROM SUAKIN TO BERBER AND KHARTUM.

questions of the things themselves. They do not care to pull the doll or the toy to pieces: they would rather be told what it is made of than take the trouble to examine it. The element of curiosity seems to have been educated out of them, and their only idea of teaching elementary science is to give the children as many facts as possible about things which they know only by their definitions. Until, then, the present happy generation of children has grown up and become ready to teach science by scientific methods, it seems evident that the plan of itinerant teaching has much to commend it. It is a plan, moreover, whose advantages ought not to be confined to the grammar-schools. Instead of putting a single overworked teacher in charge of all possible sciences in a high school, specialists might be found who would go from school to school, and carry with them an enthusiasm which it is impossible to feel for a very wide range of subjects. The Johns Hopkins university has already tested the excellence of the method for higher schools of learning. It is not impossible that the smaller colleges would gain by it if they were to adopt the plan of making occasional exchanges among their professors. In no other way could they so easily secure the specialization which is necessary for the best teaching.

AN ESTIMATE OF GENERAL GORDON'S SCIENTIFIC CHARACTERISTICS.

In our eagerness to honor a hero, there is some danger that Gordon's fame may suffer temporary injury, and that his character and the nature of his deeds may be seriously misunderstood. The popular notion seems to be, that he lived in a state of mystical exaltation, and won his strange successes by powers and processes incomprehensible, if not supernatural. Recent writing about him has dwelt so particularly upon his religious fervor, and much of it has been so intemperate and indiscriminating, that it is not strange that some shallow pamphleteers should have classed him with the prophets. He was a hero. Besides that, he was a highly educated, disciplined, and painstaking officer. He inherited military talent, and love for his profession, from generations of soldiers, and he was trained in that thoroughly scientific corps, the Royal engineers. For the first three years of his service under the khedive, he kept careful itineraries of all his marches, and, being a fine topographer, he made solid contributions to our knowledge of the geography of the upper Nile country. I have before me a dozen sketch-maps of the equatorial country, drawn by his own hand with uncommon skill. He was fond of illustrating his letters and memoranda of instructions with geographical and topographical sketches. He was minutely careful in his arrangements for solidifying and extending his communications and positions, fertile and ingenious in applying his knowledge. If we ever learn the details of his defence of Khartum, we shall probably be as much astonished by its mechanical side as by its higher intellectual and moral qualities.

From the beginning of his career before Stevastopol, "He had a personal knowledge of the enemy's movements, such as no other officer attained." His knowledge of the people of the Sudan, of their sheiks and fakirs, and of the Egyptian officers serving there, was remarkable. He had great capacity for detail; but his mental processes were so rapid, and his perceptions so keen, that he was often thought illogical by those who could not keep up with him. He was often misjudged, too, because he would not bother to explain all his steps.

Far from being a mystic, he was wide awake and practical. In Africa and in China he was constantly vigilant in keeping his powder dry. The clothes, food, pay, and sanitary conditions of his soldiers were diligently watched over. The infirmities of temper of his subordinates were well understood and provided for. His campaign in China may well be studied as a shining example of skilfully planned warfare; and his scheme for the better government of the Sudan involved twelve years of logical and systematic development, before its effect could be fully felt.

Let no one think that Gordon mounted his camel and rode into the desert, or seized his stick and led his rascals up to the mouths of the Chinese cannon, with a magnificent but blind faith. He was a laborious student of the problem in hand, he had a keen intelligence, his judgment was prompt and accurate, he was patient and far-seeing, his will was indomitable; but, above all, he had eliminated himself entirely from his problem. This made Gordon great. He could see what other men could not, and do what they dared not, because he was as unselfish as a human being can be.

H. G. Prout.

THE ROUTE FROM SUAKIN TO BERBER.

THIS route, estimated by General Gordon during his rapid passage over it in 1874 as about 288 miles in length, and found by Major Prout in his careful reconnoissance in 1875 to be about 255 to 260 miles, is one presenting great and peculiar difficulties to the march over it of a large body of troops; especially between the months of March and November, when the heat is excessive, and when those troops may be required to deal, during the march, with hostile forces.

Starting at sea-level at Suakin, it ends at an altitude of about 1,240 feet on the Nile, at Berber, after having attained at one point an altitude of nearly 3,000 feet.

In its entire length it is practically, *for a large force*, a barren, treeless, waterless desert, but quite different for a small detachment of a few hundred men with their necessary animals. For a large force (say, 5,000 to 10,000 men) the water used by men and horses must in some manner be transported with them or in advance of them.

The wells and water-holes on the whole line may be quickly named and described, as follows: at about 2 miles from Suakin are the wells which furnish water to the town; and here a good supply for a large force may be had. The next water is at El Hundouk, about 9 miles out. These wells furnish partly sweet and partly brackish water, sufficient for about 250 men and 500 animals. At about 17 miles out are the wells of O-Taon, with capacity for, say, 250 men and their horses. In the valley of Sinkat, at about 23 miles, 200 men with 500 animals can usually be supplied by shallow water-holes, which are called the wells of Hambouk; and it is probable, that, by using care, this result might be doubled. Sinkat, nearly 1,000 feet above sea-level, was, in former times of peace and good government, used as a summer residence by the richer merchants of Suakin.

At about 40 miles from Suakin, the wells of Kissibil can furnish good water for a small party, say, a general officer with his staff and escort; and thence on, no water is found until Wady Haratree is reached, at about 64 miles out. Here 600 men and as many animals can drink. Eleven miles farther on, an equally good supply is found at the wells of Salalaat.

The next supply worth mentioning is the well of Abd-el-Hab, where perhaps two battalions might be supplied. This excellent well is $97\frac{1}{2}$ miles from Suakin. At El Ariab, about 118 miles from Suakin, there are three large wells, well constructed, and furnishing good water, in quantity large enough for two or three battalions, with a fair proportion of animals, — a strategic point which should be held by a permanent garrison if the road is to be used.

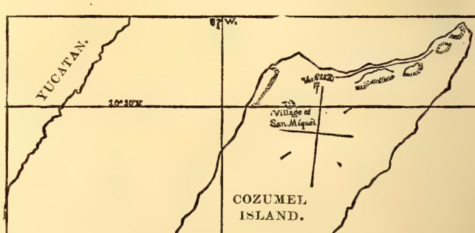
From El Ariab to O-Baek, a distance of nearly 60 miles, no water is found; and even at O-Baek the supply is very disappointing to thirsty marchers, since it is hardly sufficient for a battalion with its animals, and is often brackish. Thence on, the route is in blank desert until within six miles of Berber.

Thus it is seen that on the eastern half of the route there is scant supply of water for the advanced guard of a strong division, while on the western half there is practically no water until within six miles of Berber. Throughout the line, cannon and wagons can be drawn with little difficulty; but the eastern half passes frequently through narrow and tortuous defiles, which an active and intelligent enemy would render extremely dangerous to a marching force.

C. P. STONE.

THE ISLAND OF COZUMEL.

DURING the night of Jan. 22 last, the U.S. fish-commission steamer Albatross was anchored off the northern end of the island of Cozumel, on the east coast of Yucatan, and on the 23d steamed along the western side of the island to an anchorage off the village of



San Miguel, four miles from its north-west end. The naturalists went ashore next day in two divisions, — a shore party and a seining party, the latter aided by men from the ship. Both were remarkably successful, the birds collected

(the only material yet examined) comprising thirteen new species and two new sub-species.

On the 24th the photographer, Mr. N. B. Miller, was sent in the steam-launch to visit the plantation of Mr. J. B. Anduze, in the southern part of the island, some twelve miles away. Mr. Miller's report, which is forwarded with Capt. Tanner's (noticed in No. 113) describes the shores as generally low, with a notable exception occurring at the mouth of a creek, five miles from San Miguel, where the shores are bold enough to allow vessels of eighty tons to lie alongside to load. His party was landed through the surf on the backs of Indians, and rode to Mr. Anduze's plantation upon ponies, through a dense forest closed in by interlacing vines so as to shut out the sun, and agreeably remarkable for the absence of buzzing insects. The plantation was about a mile and a half square, enclosed by a high stone wall. It abounded in bananas, plantains, pine-apples, corn, ginger, oranges, and lemons, but seemed to be carelessly or inefficiently cultivated. The main house was stone, with a thatched roof, surrounded by five large sheds arranged in a square.

INDIAN VILLAGE ON THE ISLAND OF COZUMEL.

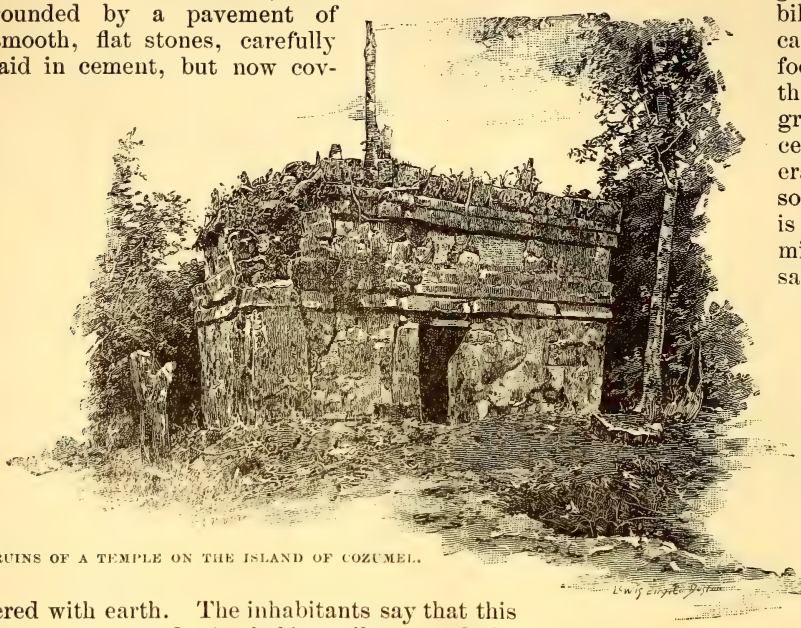
Near by was a small Indian village of some fifty huts, but only thirty families. The huts were of the ordinary single-room type, with hammocks triced up against the roof in the daytime; the floor of cement, raised about a foot from the ground, and kept scrupulously clean. The natives were bright mulatto in complexion, with long, straight, coarse black hair; neater and more intelligent than those of the village of San Miguel. The men were short, not over five feet four inches in height, and wore scanty black beards: the women were neatly dressed in loose white gowns. This village differed from others visited, in its unusual cleanliness, and in the fact that the cattle were not allowed to run loose, but were penned up within high stone-walled enclosures. Some of the older Indians knew no Spanish, and all were acquainted with the native dialect.

The small Roman-Catholic church of the village had fallen into ruin because of a curious circumstance. Some remarkable spiritualistic manifestations had taken place there several years ago, and as a consequence the whole village had become a community of spiritualists. It would be interesting to know whether this remarkable conversion was the result of missionary effort, if there be any such among spiritualists, or arose from indigenous 'manifestations.'

On the edge of the village are the ruins of a large structure, supposed to have been a temple, which both Indians and whites declare to date beyond the Spanish conquest. Nothing definite could be learned, beyond the legend that Cortes had landed there and destroyed the building before going to the mainland. The ruins could be traced over about half an acre, now covered by large trees. Only a central tower, or part of it, is now standing. Into this there is but one entrance, opening into a narrow, vaulted room. Markings were noticed on the plaster covering the walls, and stone hooks cemented to the same. Within a radius of half a mile are the ruins of many stone arches,

as to which the Indians declare that the island was once the cemetery for the neighboring mainland, and therefore will not allow the mounds to be explored.

Subsequently, near the village of San Miguel, Mr. Miller examined and photographed the ruins of an old church, surrounded by a pavement of smooth, flat stones, carefully laid in cement, but now covered with earth. The inhabitants say that this pavement extends for half a mile around the church, and that a broad, paved way once led from the church to the water, a mile away.



RUINS OF A TEMPLE ON THE ISLAND OF COZUMEL.

ERRORS IN DIGESTION EXPERIMENTS.

HENNEBERG and Stohmann, in their *Beiträge zur rationellen fütterung der wiederkäuer*, published in 1860, reported practically the first determinations of the digestibility of the proximate constituents of cattle-foods. Since that time, a large number of similar determinations upon various fodders, and with the several species of domestic animals, have been made, chiefly, if not entirely, by the German experiment-stations. In these determinations the method employed by Henneberg and Stohmann, and which is here given in outline, has been universally followed.

The food of the animal is weighed, suitable account being taken of any portion left uneaten, and a sample of the food is subjected to chemical analysis. The solid excrement of the animal, which consists for the most part of the undigested portions of the food, is also carefully collected, weighed, and analyzed. From these data, it is a simple matter to compute how much dry matter or how much of any particular ingredient of the food the animal received, and what part of this failed to be digested.

This method of experiment evidently will give directly the digestibility of any fodder which can be made the exclusive food of the animal. In the case of material like grain, meal, and the concentrated fodders in general, the matter is not quite so simple. In this case it is first necessary to determine the digestibility of a sample of hay, or other coarse fodder. This done, the animal is given a mixture of this coarse fodder and the concentrated fodder in question, and the amount of this mixture which is digested is determined. Then, on the assumption that the same proportion of the coarse fodder was digested in the second trial as in the first, we calculate how much of the concentrated fodder must have been digested in order to yield the results observed upon the mixture.

Certain sources of error have been ignored in the general statement given above. Thus the excretion is always more or less irregular from day to day; and the excreted matter contains, in addition to undigested food, more or less intestinal mucus, and remnants of digestive juices, which, though small in amount relatively, are not entirely to be neglected. Then it has recently been shown that some portions of the food fail to appear in the excreta, because they suffer a fermentation in the alimentary canal, rather than because they are digested in any proper sense. This is particularly the case with cellulose (see *Science*, No. 100, p. 11). Finally, the methods of analysis in use for fodder and excrement are not in all respects capable of giving sharply defined results.

Another class of errors, the small unavoidable errors of weighing and chemical analysis, usually less considered, may grow to very considerable dimensions when multiplied many

times in computing the composition of large amounts of fodder from that of small samples. In some recent digestion experiments made by the writer at the Wisconsin agricultural experiment-station, a computation was made of the influence of these analytical errors, with results very similar to those arrived at by Kühn [1] in a paper on the effect of cooking and other methods of preparation, upon the digestibility of wheat-bran.

In both cases it was assumed that no material loss of either fodder or excrement had occurred. In view of the care taken in the conduct of the experiments, this assumption seems justified. It at least does not magnify the probable error. It was likewise assumed that the sampling was free from error. In the writer's experiments, analyses of four samples of the same hay agreed so closely as to justify the assumption. In short, the computations were confined to the effect of *analytical errors* upon the results.

With these explanations, we give below a statement of the errors to which the several determinations were found to be subject: —

Probable errors. — Hay.

	Kühn's experiments.	Armsby's experiments.
	Per cent.	*Per cent.*
Dry matter	–	± 0.08
Organic matter	± 0.1	–
Proteine (N × 6.25) . .	± 2.1	± 1.15
Crude fibre	± 1.9	± 0.62
Fat (ether extract) . . .	± 2.5	–

It should, perhaps, be added, that the results of a digestion experiment are usually expressed in per cent of the amount fed. The above results mean, that if, for example, 50% of the proteine fed was found to have been digested, the true amount in the writer's experiments was probably not less than 48.85% nor more than 51.15%.

That the probable error appears smaller in the writer's experiments is largely due to the methods of calculation employed. No strict rules can be followed in such a computation, but a considerable field must be left for the exercise of good judgment. Kühn wished to avoid making the error appear too small: the writer, with a somewhat different purpose in view, wished to avoid exaggerating it. It is plain that in both experiments a reasonable degree of accuracy was attained.

Next let us turn to the results upon by-fodders. Here, owing to the method necessarily employed (see above), the errors are, so to speak, concentrated in the by-fodder, as the following statement shows: —

[1] *Landw. versuchs-stationen*, xxix. 1.

Probable errors. — By-fodders.

	Kühn's experiments.[1]	Armsby's experiments.	
	Bran.	Malt sprouts.	Cottonseed-meal.
	±	±	±
	Per cent.	*Per cent.*	*Per cent.*
Dry matter . . .	–	0.5	0.5
Organic matter .	0.6	–	–
Proteine	7.7	2.8	1.6
Crude fibre . . .	7.2	6.8	31.0
Fat	25.6	–	–

[1] Calculated by the writer.

It is evident from these results that determinations of the digestibility of concentrated fodders are subject to a somewhat considerable error. When they contain but little of an ingredient, the relative error may be very large, as in the case of the crude fibre of the cottonseed-meal, while, if the ingredient is present in larger amount, as in the malt sprouts and bran, the relative error is reduced.

In both Kühn's and the writer's experiments, however, a second source of uncertainty was discovered in the fact that the same animal may digest the same fodder to a somewhat different extent at different times. The writer's experiments show one unmistakable example of this, and Kühn's several.

Now, as stated above, the calculation of the digestibility of a concentrated fodder is based on the assumption of unaltered digestibility of the coarse fodder. If this assumption is not true, the whole of the error thus introduced will, by the method of computation employed, attach to the concentrated fodder. The following statement shows what very considerable errors may arise from this source, combined with the analytical errors above noted: —

Possible errors.

	Kühn's experiments.	Armsby's experiments.	
	Bran.	Malt sprouts.	Cottonseed-meal.
	±	±	±
	Per cent.	*Per cent.*	*Per cent.*
Dry matter . . .	11.5	4.3	4.7
Organic matter .	9.6	–	–
Proteine	15.4	5.7	3.2
Crude fibre . . .	91.5	10.9	52.4
Fat	36.1	–	–

The experiments which we have been considering compare favorably as to methods and care with previous experiments of the same sort; and it does not seem unwarranted to conclude that those, also, are subject to errors of somewhat the same magnitude. It appears plain that we can, with proper care, determine the digestibility of the total ration fed with a very satisfactory degree of accuracy; but it seems equally plain that we cannot compute from that result the digestibility of any single fodder composing the ration with the hope of obtaining any thing more than approximately correct figures. The data which we have for the digestibility of the concentrated fodders are of more or less value for practical purposes, since they are usually the average of several determinations; but for scientific purposes such determinations are of very doubtful value.

H. P. ARMSBY.

AN ANTHROPOMETRIC LABORATORY.

IN the February number of the Journal of the Anthropological institute of Great Britain and Ireland, Mr. Francis Galton describes the laboratory which he established at the International health exhibition to familiarize the public with simple methods of measuring and recording many of the physical characteristics of man. The instruments in action dealt with keenness of sight, color-sense, judgment of eye, hearing, highest audible note, breathing-power, strength of pull and squeeze, swiftness of blow, span of arms, height standing and sitting, and weight. Some other apparatus not in actual use, such as a balance to determine delicacy of touch, was exhibited.

All these instruments were so contrived as to economize the time of the attendant; so that, although each person measured was in the laboratory about twenty minutes, he consumed but seven minutes of the attendant's time. Thus it was possible to measure ninety persons daily, and cover the running expenses of the laboratory with a tax of threepence each. Of course, the reduction of expense to a minimum gives a much broader field for work, especially in introducing periodic systematic measurements into schools, which is one of the ultimate objects of this demonstration.

Keenness of sight, or power of accommodation of the eye, was measured by means of an original instrument of a flat, sickle-shape, upon which were set upright, at regular intervals, small blocks of wood, covered below with printing in diamond type, and having printed at the top in large type the distance in inches from the eye-piece. The number of inches at which the diamond-type is legible is an expression of the accommodating power. This test showed, that, of 850 persons, forty per cent had both eyes equally effective, while sixty per cent had a notable difference in the power of the two eyes. The average difference between the two eyes was two inches; but the average strength of the right and left eye was almost exactly the same. The color-test was Holmgren's light-green test, nicely arranged to economize time. Judgment of the eye in dividing a line into halves, and in setting a movable arm square upon a board, were tested in ingenious ways, which doubtless among children would express the native quality, but oftentimes among adults would be only a measure of facility acquired by occupation. The highest audible note was measured by five whistles, set to emit 10,000, 20,000, 30,000, 40,000, and 50,000 vibrations per second respectively. Of 317 males between forty and fifty years of age, a hundred per cent heard the first whistle, to four per cent who heard the last. In this, as in every other particular, the males excel the females.

The spirometer used consists of a counterpoised vessel suspended in water, which rises as air is breathed into it, and shows the number of cubic inches of displacement by a scale at its side. The breathing-capacity increases rapidly in early youth, becomes stationary between twenty and thirty, or a little later, and thenceforward steadily declines. Up to the age of twenty, the breathing-capacity has been the same for both sexes; but at that age that of the males becomes half as great again, — a ratio which is maintained throughout after-life. Unexpectedly, it appears that there is no close relation between the breathing-capacity and the strength of pull or of squeeze. The latter, which were estimated by means of Salter's instruments for the purpose, show that the left hand is about six per cent weaker than the right, and that women are weaker than men. Of the 1,657 adult women measured at the laboratory, the strongest could exert a strength of squeeze of but eighty-six pounds, or about that of an average man.

For the first time, swiftness of blow was measured, either of a blow delivered with the fist straight at a pad upon one end of a flat bar running freely between guides, or of a pull, by holding a stirrup attached by a string to a similar bar, and striking out into space. The swiftness is registered by means of a spring with pencil attached, which is set free, and vibrates transversely as soon as the bar begins to move. The results of this measurement are not discussed.

A curious fact, which came to light on comparing the height sitting with the height standing, is, that in women an increase in stature is accompanied by a disproportionate increase in the length of the legs, while in men, for all statures up to six feet, the ratio between height sitting and height standing is the same, 54 : 100.

During the continuance of the laboratory, 9,337 persons were measured, of whom 4,726 were adult males, and 1,657 were adult females. The results of all these measurements are not fully discussed, nor has Mr. Galton perfected his ideal of a laboratory. Among other measurements which will be added to the list, are those of the head, its maximum length and breadth with graduated calipers, and its maxi-

mum height above the plane which passes through the upper edges of the orbits and the orifices of the ears. Mr. Galton adds, that while writing his account, instruments for head measurements were being solidly constructed for him, which will be in use in Cambridge, Eng., in 1885.

THE STATUS OF AERONAUTICS IN 1884.

Duroy de Bruignac, member of the French Société des ingénieurs civils, has recently presented to that association a very complete yet concise *exposé* of the present state of the art of aeronautics, especially as related to the general system of 'dirigeable' aerostats. The first indications of success are assumed to have been given by the experiments of Giffard (1852–55), Dupuy de Lôme (1871), and Tissandier and Renard and Krebs (recently). The first condition is considered to be stability, retaining the relative position of parts seen in the earlier balloons.

Giffard, in his earliest attempts, attained a speed of three, and later of four, metres per second. Dupuy de Lôme, and Renard and Krebs, have used better forms of balloon, and have secured more rigidity of structure; but none have obtained high speed.

Extreme lightness of motor is a vitally essential feature; and the best that has yet been done is illustrated by the steam-engines of Thorneycroft, weighing about 33 kilograms (73 pounds) per horse-power, and which, by sacrificing economy of fuel, it is thought possible may be reduced to 20 kilos (44 pounds), and the various storage and other batteries yielding electricity, which, according to Tissandier, may be reduced to a weight not exceeding 25 kilos (55 pounds) per horse-power. Messrs. Renard and Krebs claim a weight as low as 17 or 19 kilos. The experiment of Tissandier in 1883, in the application of electricity to this work, is thus expected to lead to useful results.

The propelling instrument is always the screw. Its position is a matter of importance. As usually arranged, it has a tendency to cause vertical deviations of the machine, which are objectionable. It is hoped that it may prove possible to place the screw-shaft in line with the axis of symmetry of the balloon, in order to avoid this difficulty. This may be done by setting it between a pair of spindle-shaped supporting balloons. It is uncertain whether it will be found best to place it ahead or astern of the balloon; but it is presumed best at the stern. The screw is objectionable on the score of its low efficiency, — about 0.30 (?); but nothing better has yet been devised.

Bruignac proposes a formula by means of which to calculate the resistance of the aerostat, and by its application determines the relative resistances of the machines of the several aeronauts whose work has been mentioned, as follows: Giffard, 1852, 0.076; Giffard, 1855, 0.035; Dupuy de Lôme, 0.18; Tissandier, 0.12; Renard and Krebs (1), 0.12; Renard and Krebs (2), 0.02. In the last two cases, the large and the small ends of the vessel are calculated separately.

The speeds actually obtained by them were 5.5 metres per second by the last named, and from 3 to 4 metres by their predecessors. Had the former driven their machines with the small end ahead, instead of the larger end, as actually practised, the critic calculates that they might have obtained a speed of nearly ten metres. A symmetrically formed cylindrical spindle is advised as the probably best form for the body of the air-ship, inserting a straight middle body when constructing very large vessels. The larger the machine, the lighter, comparatively, will be the driving machinery. The substitution of supporting hoods, sheets, or tissues, for cords, may assist in the endeavor to reduce resistances. The loss of gas by leakage can be reduced by choice of proper material for the balloon. The waste of gas in ascending and descending must be avoided, and may, perhaps, be obviated altogether. This becomes an easier matter in ascents of the kind here contemplated, in which no greater height will be sought than is sufficient to clear obstacles safely: probably a hundred metres will prove ample. For such work, the alternate compression and expansion of the adjusting volume of gas will probably suffice.

The conclusion is reached that the art of aerostation is much nearer a practically applicable state than scientific men generally suppose. The objects now sought are the attainment of better and more stable forms, the more effective arrangement of parts, the invention of lighter motors, invariable in weight, and convenient of operation, and the securing of higher efficiency of propelling instrument. Even now, with the experience of the past, it is possible to build a machine of this class capable of making at least ten metres per second through the surrounding medium.

These conclusions of Bruignac are especially interesting when compared with those of Pole as presented to the British institution of civil engineers, in which he finds that the supporting-power of the balloons adopted by the aeronauts above mentioned, and the driving-power and weights of the torpedo-boat engines of British makers, are such as should permit the construction of an air-ship four hundred feet long, to travel at the rate of thirty miles an hour.

R. H. Thurston.

FINDING A BORE-HOLE.

Two novel and ingenious methods of locating the position of a bore-hole have recently been described in the London *Engineering*. In the first case, at Edinburgh, it was desired to connect the lower end of a bore-hole, two hundred feet deep, with a well some eighteen feet distant. A drift run in the supposed direction failed to strike the hole, although much rock was cut away, and it was evident that the drill had deviated considerably from the vertical. After an unsuccessful attempt to locate its direction

by the sound arising from shaking rods within it, Mr. Andrew Haddow, the engineer, lowered four eight-inch bar-magnets (placed end to end, with the south pole down) into the bore. The north pole of a compass-needle in the mine moved first to the west, and then to the east, of magnetic north, as the magnets were lowered, indicating that the magnets were to the westward of the compass. While the heading was being enlarged in this direction, Mr. Haddow experimented by passing a magnet around the compass, and drawing a series of curves for positions of the magnet, which produced different angular deflections of the needle. The compass was then placed successively at two different points in the heading, and the deflections caused by the magnets in the bore-hole were noted, — at one point $3\frac{7}{8}°$, at the other $6\frac{1}{2}°$. The two points were then marked on the plan of the mine, a tracing of the magnetic curves just referred to was placed over each point, and the intersection of the curves corresponding to these deflections was noted. Upon excavating to the point thus indicated, the bore was found, being about eight feet from the true vertical.

In a second case, in Australia, the diamond drill, in going down three hundred and seventy feet, had deviated beyond sensible magnetic influence, and the search by underground mining was continued for nearly twelve months without success. Mr. E. F. Macgeorge then employed glass phials partly filled with melted gelatine, and having a compass-needle in a lower connected bulb of the phial. When these were carefully lowered in the bore to different depths, and the gelatine congealed, the needle would become fixed in the magnetic north, and the surface of the gelatine would be horizontal. These two indications, when the phial was withdrawn, showed the inclination and magnetic bearing of the bore-hole at that point; and a sufficient number of observations at convenient depths permitted the erratic bore-hole to be completely mapped from top to bottom. This map showed a deviation of nearly forty feet at three hundred and seventy feet down (the point so long searched for), and of between seventy and eighty feet at the full depth of five hundred feet. A drift straight for the indicated spot found the lost bore thirty-seven feet and a half away from its proper place, and the bottom was found seventy-five feet astray. This device has since been perfected and patented.

FISHING-INTERESTS IN HUDSON BAY.

THE chief commercial value of this district undoubtedly lies in its immense fishing-interests, if we include in that term whaling and sealing.

American whaling-vessels have for more than a quarter of a century been conducting a very profitable fishery in Roe's Welcome, a large basin in the north-western portion of Hudson Bay. The vessels usually leave New England in July, and reach Marble Island in September, where they winter, one or two every season, and occasionally more. Sawing out of the ice in the following June, and pressing northward as fast as the ice will permit, they fish until about the first of September, unless sooner loaded, and then sail for home. During the eleven years preceding 1874, about fifty voyages are known to have been made; and the returns give an average of $27,420 per voyage, which shows a large margin of profit to the small sailing-vessels usually engaged in the trade. It is estimated that the aggregate value of oil and whalebone already obtained is about two and a quarter million dollars, and every thing points to a large extension of the industry.

The porpoise-fishery is extensively carried on by the Hudson-Bay company; the fish, as they are popularly called, being held in check by means of trapnets on flats in coves where the tide rises ten or fifteen feet, and left high and dry when the water recedes. Last year the company secured nearly two hundred in one tide at Churchill, and a much larger number at Ungava Bay. The blubber weighs from two hundred and fifty to four hundred pounds, and is very rich in the finest of oil. Formerly the blubber was exported; but the company has established extensive refineries at several of its northern stations, and now ships the oil in casks.

The company also carries on a walrus-hunt, sending two sloops annually from Churchill to two very productive walrus-grounds north of Marble Island, where they have never failed to obtain full cargoes of blubber, ivory, and hides in a few weeks, besides carrying on a valuable trade in oil, ivory, musk-ox, and other skins, with the northern Eskimo.

During the exploring-steamer Neptune's visit to Stupart's Bay, the Eskimo were living on the harp-seal (Phoca groenlandica Linné), and had in their possession skins of a good many harbor and square-flipper seals (Phoca vitulina Linné, and Erignathus barbatus Fabricius), seals of all kinds being abundant.

The Hudson-Bay company has a steamer, the Diana, plying between London and Ungava Bay direct, fitted up with refrigerating apparatus, and engaged solely in conveying salmon fresh to the London market. Last year's cargo is reported to have realized eighteen thousand dollars. Nearly every stream contains both salmon and trout in vast quantities, chiefly where the salt and fresh waters mingle.

Cod abound in the vicinity of Chudleigh, though not up to the present time found in Hudson Bay. Newfoundland schooners even now work as far north as Nachvak, and seem to be going farther each year. The cod, though good, are not equal to those of the Banks. While the Neptune was at Port Burwell, both in going and on returning, the anchorage teemed with cod, which were taken in great numbers by jigging from the ship's deck.

THE DRAINAGE SYSTEM OF BRAZIL.[1]

THE hydrographic features of Brazil are to a certain extent determined by the orographic system, and by the distribution of mountains and plains described

[1] From the Rio *News*.

in *Science*, No. 112. They are, however, still more dependent on the general structure of South America; since almost all of the great Brazilian rivers belong to hydrographic systems which interest other parts of the continent outside of the Brazilian plateau.

South America is made up of three great masses of highlands, in great part mountainous, more or less completely separated by depressed areas, in which flow the great rivers Amazonas, Orinoco, and Paraguay; the latter, rather than the Paraná, being taken as the dominant feature of the La Plata system.[1] These masses of highlands are, the long and narrow Andean plateau, the Brazilian plateau, and the plateau of Guiana. The Andean plateau, being very near the Pacific coast, throws nearly all the drainage of the continent eastwards to the Atlantic; while the plateaus of Brazil and Guiana force the waters to flow northward to the Caribbean Sea, southward to the South Atlantic, or eastward through the central basin, or great Amazonian depression which separates them. Thus the Paraguay has a southerly course in the centre of the great depression between the Andean highlands and those of Brazil, receiving a considerable part of the drainage of both; the Orinoco bears the same relation to the highlands of the Andes and of Guiana, which give a northerly course tò the drainage; while the vaster Amazonas has relations with all three of the continental plateaus, rising in the Andes, and flowing between the highlands of Brazil and of Guiana, receiving tribute from both of them, while by means of its great tributaries, the Madeira, Rio Negro, and others above them, it includes in its basin a considerable portion of the great depression between the Andes and the two detached eastern plateaus of the continent.

With few exceptions, all the great rivers of South America belong to one or the other of these basins, which may be called continental, because they pertain to more than one of the great component parts of the continent. The other rivers belong to one or another of the three plateaus; and of these, those of Brazil are the largest and most important, because the Brazilian plateau is larger than that of Guiana, and better watered than the part of the Andes that drains into the central depressions. Considering the Uruguay as belonging to the La Plata system, the exclusively Brazilian rivers (in a geographical sense) are those that flow from the eastern watershed of the plateau directly to the Atlantic. If, however, not only those that have their course in the country, but also those that commence or terminate in it, are considered as Brazilian, the rivers group themselves naturally into three great divisions; viz., those that flow directly to the Atlantic, and those that form part of the Amazonian and Platine systems.

The great watershed of the empire, that which separates the indirect from the direct Atlantic drainage, is determined by the orographic features already described. It does not, however, follow continuously the culminating orographic lines, but rather passes from one to another of these lines by means of the transverse ridges which unite them. Thus in the south the Atlantic-Paraná divide is formed by the culminating ridges of the southern part of the Serra do Mar; in the central portion the Paraná-São Francisco divide is formed by the Serra da Canastra, or Matta da Corda, in western Minas, and by the transverse ridges which unite this chain with the Mantiqueira branch of the Serra do Mar, and with the mountains of Goyaz; in the northern portion of the great watershed the divide is formed by the extensive ridge, which, branching off from the Goyaz Mountains, accompanies all the course of the Tocantins, — a ridge whose true orographic character is, as stated in a previous article, very imperfectly known.

The secondary watershed, which divides the waters of the Amazonas from those of the La Plata system, is well defined and regular in the part between the Araguaya-Tocantins and the Paraná, being formed by the mountains of southern Goyaz, which extend from south-west to north-east; but farther west, between the Paraguay on the one side, and the Xingú, Tapajós, and Guaporé, of the Amazonian system, on the other, the divide is near the irregular jagged margin of the Amazonian tableland, and is not marked by any notable elevation of the surface; and the passage from one system to the other is comparatively easy. Thus in the detached Serra do Aguapehy, which seems to be an outlier of the southern margin of the tableland, rise the Rio Alegre — one of the head waters of the Guaporé — and the Aguapehy, which, through the Jaurú, discharges into the Paraguay. In the lower lands at the base of the serra, and after both these streams have become navigable for small craft, they flow for a certain distance near together; and the intervening land affords two practicable portages of the extension of 8,640 metres and 11,708 metres respectively, over which boats have been passed from the waters of the Paraguay to those of the Amazonas, or *vice versa*. In 1773 an attempt was made to open a canal across the shortest of these portages, which, like the Cassiquiari, should serve to unite two great basins, and afford uninterrupted fluvial communication from the mouth of the La Plata to that of the Orinoco. The attempt was, however, abandoned; and accurate levelling will probably show that the project is impracticable. There are also two practicable portages between the affluents of the upper Tapajós and the Cuyabá, a tributary of the Paraguay. One of these is only 1,285 metres wide; and canoes with cargoes of Amazonian products have frequently been transported to the waters of the Paraguay. As in this region the Tapajós flows at a much higher level than the Cuyabá (at least, in its navigable portion), the difference of level to be overcome is probably much greater than in the case of the Alegre and Aguapehy.

In consequence of the disposition of the highlands and lowlands above indicated, there is a great difference between the rivers of these two divisions, which is of capital importance with reference to the internal communications of the empire. The Amazonas and Paraguay, being pre-eminently rivers of the depressions (the first descends to a level of less than 100 metres very near to the foot of the Andes, and the

[1] See the map on p. 274.

latter flows at an elevation of only 123 metres at Cuyabá near its source), afford uninterrupted navigation for almost their entire course. The tributaries of these two rivers, and the other Brazilian rivers in general, are, however, plateau streams, and have two navigable portions, — one on the upper stream on the plateau; and the other in the depression, or coast border region. The difference of level between these two portions is one or more hundred metres, and the descent has to be accomplished by a series of cataracts situated at a relatively short distance above the mouth of the river. Of these, the most notable are the Paulo Affonso cataract on the São Francisco, and the Sete Quedas ('seven falls') on the Paraná. The upper tributaries of the Amazonas, between the foot of the Andes and the Rio Negro on the north, and the Madeira on the south, are exceptions to this rule; since they descend from the plateau on which they rise in their upper courses, and afford long lines of navigation. They thus reveal the interesting fact that a vast area of the almost unknown upper Amazonian region is at a much lower level than the adjacent plateaus. Of the rivers that flow directly to the Atlantic, those of the province of Maranhão and the Parnahyba, in Piauhy, offer the greatest facilities for navigation; because they rise at a lower level than the rivers to the southward, and effect their descent to the sea-level by a gradual slope distributed along the whole course, instead of being concentrated in one or more grand series of rapids.

The Amazonas and Paraguay present peculiar features in the very extensive alluvial plains that border the main river and the lower courses of their tributaries, and in the great number of anastomosing lateral channels that cut these plains and put the main river in communication with the tributaries, often at long distances above the junction, and these last with each other. These canals are particularly notable in the case of the Amazonas, where they are called *paranamirins*, or *furos;* [1] and it is said that a boat may traverse almost the entire length of the Amazonas valley without entering the main stream. The formation of these canals is to be attributed in part to the formation of alluvial islands that are constantly being created by the sediment-loaded waters of the great river. The number and character of many of them, and especially of the *furos*, seem, however, to indicate a more general cause, and suggest the idea, that, since a relatively slight depression of the surface would transform the river-valley into an estuary, it may reasonably be supposed that at some time a correspondingly slight elevation has transformed an estuary into a river-valley. The long distance to which the influence of the tide (it is sensible at Obydos five hundred miles above the mouth of the Amazonas) is felt, gives an air of probability to this hypothesis. In this case the present tributaries would have been independent rivers, and would naturally have had deltas, the canals of which would in part become closed, and in part be transformed into *furos*, when the estuary was changed into a river.

[1] The former are canals that return to the same river from which they parted; the latter, those that unite two distinct rivers.

The *paranamirins* would in this hypothesis represent the marine channels of the muddy bottom of the estuary. It is certain that the lower portion of the Amazonas valley still presents so much of the character of an estuary, that a question has arisen among geographers as to whether the Tocantins should be considered as a tributary, or an independent river. The fact that it receives a considerable quantity of water from the Amazonas through various *furos* decides the question of its being a tributary, since the Amazonas contributes much more water than the Tocantins to the so-called Pará River, which is only the southern branch of the great Amazonian estuary.

Attention has often been called to the curious fact, that, unlike most large sediment-loaded rivers, the Amazonas has no delta. The reason appears to be, that its lower course is still in a transition state between the estuary and fluvial conditions; and the delta is not to be looked for at what is generally considered as the mouth of the river, but higher up at the head of the estuary. In this case the network of canals between the mouth of the Xingú and the western end of the island of Marajó may be considered as the true delta.

In a certain sense, the La Plata basin is a triple one, since a slight change of level, which should take the head of the estuary to the mouth of the Paraná, would effect the separation of the Paraguay, Paraná, and Uruguay as three distinct basins. Although smaller than the Paraná, the Paraguay should be considered as the main stream on account of its relations with the elevated portions of the continent to the east and west. The Paraná, as already stated, is essentially a highland river. Its tributaries flow into it before it enters the depression by the great cataract of Sete Quedas. The only exception is the Iguassú, which has its great cataract of Santa Maria close to the junction. A peculiarity of the Paraná is that the eastern margin of its basin is so close to the Atlantic, that one of its tributaries, the Tieté, may be said to rise in sight of the sea. Another peculiar feature is the tendency of its eastern tributaries, especially marked in the case of the Tieté, to flow in a north-westerly direction, as if they were seeking the source, rather than the mouth, of the main river. This indicates a general north-westerly slope in this part of the plateau.

A few peculiarities in the principal rivers of the direct Atlantic drainage system, which indicate interesting points in the topographical structure of the country, may be mentioned here. Such a point is the general parallelism of the São Francisco to the coast-line in the greater part of its course, due to the river being confined behind the Serra do Espinhaço, which, terminating to the northward, finally permits the river to escape, and direct its course toward the sea, making a right angle to its former course. The same phenomenon is presented in a still more interesting manner by the Parahyba, which exhibits a double parallelism, the river making a U-curve in the upper part of its course, and, after a course of about two hundred miles, passing close by its source. This is due to a

subordinate member of the Serra do Mar system (the Serra da Bocaina, or Quebra Cangalha), which, being intercalated between the maritime range and the Serra da Mantiqueira, impels the river to the south, until, escaping around the end of this barrier, it encounters another in the Mantiqueira, which forces it northward until it finds a passage across the Serra do Mar, and escapes to the sea. The Iguape, or Ribeira, in southern São Paulo, with its northern tributary the Juquiá, reveals the same fact of the splitting-up of the maritime range into distinct ridges.

O. A. DERBY.

IRVING ON THE COPPER-BEARING ROCKS OF LAKE SUPERIOR.

IN his opening chapter, Professor Irving gives a succinct history of the earlier investigations of the copper-bearing rocks of Lake Superior, a clear exposition of the views that have been held respecting them, and a full bibliography of his subject. The discussion proper is introduced by a sketch of the extent and leading characters of the formation, illustrated by an excellent map. This is the first really synoptical view of the series, in any thing like its regional entirety, that has been presented.

Instead of a mere local phase of some well-known geological horizon, it is described as a unique formation of consistent characters and enormous thickness, stretching out to an ascertained length of five hundred miles, with a width of a hundred miles, and an area, excluding the Nipigon extension in Canada, of forty-one thousand square miles, — nearly two-thirds the size of New England. "Throughout this wide extent, though local peculiarities are to be noted, the general characteristics of the group are wonderfully constant." It consists of an enormous series of eruptive sheets, — lava overflows in the main, — among which are intercalated beds of sandstones and conglomerates, and over which lies a great thickness (fifteen thousand feet) of detrital material, making a total pile of forty thousand feet.

A careful description of these rocks next follows, illustrated by very fine microscopic sections, and conveniently summarized in tables. The studies of Professor Irving do not add greatly to the kinds of basic rock previously described by Professor Pumpelly in the reports of Michigan and Wisconsin; viz., diabases, malaphyrs, and gabbros. He has, however, amplified the varieties and the geographical distribution of these, and added an interesting anorthite rock. To the acid eruptives he has made a more notable contribution in determining not only the presence, which was partially known before, but the important development of quartzless porphyries, quartziferous porphyries, felsites, augite syenites, granitells, and granites. He shows that these are, at the same time, members of the original eruptives, and chief contributors to the detrital beds, especially the conglomerates. But more completely new and theoretically important is the recognition of a class of intermediate rocks (silica from fifty-two to sixty per cent) which constitute phases of the orthoclase, uralitic, and hornblende gabbros, and of the diabases, diabase porphyries, and their amygdaloidal forms. The detrital rocks are conglomerates and sandstones, with shaly phases. They are chiefly derived from the acid eruptives, though where closely associated with basic rocks, a large element is derived from these. In some parts a notable contribution has been made by the older crystalline rocks.

The lithological discussions are critical, and evince a familiarity with the latest phases of this rapidly developing branch of study. They embrace a hundred and eighteen pages.

Following this are nearly two hundred pages devoted to the stratigraphy of the series. The author maintains with justness, that the igneous beds, being overflow sheets, are fully amenable to the common laws of stratigraphy; and his discussion is notably free from the license of eruptive geology. He brings together for the first time, from his own and others' observations, specific descriptions of the formation from all sides of the Lake-Superior basin. It is to be hoped that in this he inaugurates a new era in the discussion of Lake-Superior geology, in which the study of its problems shall be cosmopolitan, in distinction from that narrow provincialism or that distant unfamiliarity which has so largely vexed their past history. Professor Irving's descriptions necessarily fall much short of full completeness; but they constitute a great advance in the endeavor to give, by precise descriptions, maps, and sections, an approximately accurate conception of the entire formation, so far as displayed in the Superior region. Completeness will only be approached when it is possible to extend over the whole region such excellent detail work as that of Pumpelly and Marvine in Michigan, and the author himself in Wisconsin.

The eighth chapter of the monograph is devoted to the relations of the Keweenaw series to the associated formations, and traverses the ground which has been most contested in Lake-

Monographs of the U.S. geological survey. Vol. v. The copper-bearing rocks of Lake Superior. By ROLAND DUER IRVING. Washington, *Government*, 1883. 16+464 p., 29 pl., 37 figs. 4°.

Superior geology. To the class of formations later than the Keweenawan, he refers the fossiliferous Cambrian sandstone of the Mississippi valley, and the horizontal sandstones of the Superior basin, known in local geology as the 'eastern' and 'western' sandstones. To the series of older formations he refers the Animikie group, the original Huronian, and the Penokee, Marquette, and Menominee Huronian groups. The fossiliferous sandstone of the Mississippi valley (Potsdam) he confidently considers later than the Keweenaw series, because it unconformably overlies it, with evidence of great intervening erosion. The 'eastern' and 'western' sandstones also are held to be newer, because they adjoin the Keweenaw series by unconformable contacts associated with fault-lines. These three sandstones he refers to essentially the same horizon, — the Potsdam, or its immediate downward continuation. In support of these views, he cites a large array of specific evidence, and gives precision to his discussion by maps and diagrams. The older formations named are separated from the Keweenawan on the grounds of unconformable relations, and discordance of character.

The stratigraphical discussion is fittingly closed by a sketch of the Lake-Superior synclinal. The existence of a downward flexure embracing the western part of the basin was long since made known by Foster and Whitney. Professor Irving and his Wisconsin colleagues, a few years since, determined its south-westerly extension into the borders of the Mississippi basin. The author now makes an important extension eastward so as to embrace nearly all of the lake's area, the trough assuming a curved, rudely reniform contour.

The monograph is closed by a chapter on the copper deposits, which were, however, not special subjects of investigation.

The treatment throughout is candid and able. There is a close adherence to facts, and the conclusions that legitimately flow from them. The memoir is a valuable contribution to general geology. The horizon of which it treats has long lain under a cloud of obscurity, if not of actual chaos, in Europe as well as in America. The distinct differentiation of the formations of one important field cannot fail to aid in the study of all others. When equally explicit descriptions of other regions involving this horizon shall be at command, we shall doubtless be on the threshold of agreement as to its taxonomic place and value. Present disagreement is largely an expression of imperfect knowledge and provincial study.

WORLD-STUFF.

'WHENCE came this world?' and 'Whither is it going?' are questions of never-tiring interest to mankind, — questions upon which they have pondered for long ages, and which are still unsolved. Where is the man who, without a shudder, can turn from the beautiful life around him, and in fancy contemplate a cold, cheerless, dark, lifeless condition of the world towards which we have every reason to believe it is tending?

In the book before us we have an effort made to weave the various speculations of others, regarding the evolution of the universe, into a continuous and harmonious whole by an admixture of the author's own ideas. Professor Winchell is well known from his past efforts to popularize science, and for his speculative tendencies; and perhaps he, of all American writers, is best fitted to popularize a subject like the one he has chosen, and commend it to the interest and attention of the masses. The work is to be judged rather by its success or failure as a popular presentation of the subject, than as an original contribution to cosmical science. In either respect, the book is disappointing; for our author, instead of keeping in a field in which he has perhaps no superior in America, has attempted a middle ground. He has written so that his treatise occupies a higher plane as a scientific treatise than his previous books, although, as is the tendency of all speculative minds, the presentation of theories has been mistaken for the presentation of evidence and proof. Again: as a popular presentation of the subject, the work falls below the other books of the author, so far as we are acquainted with them, and doubtless many portions will be considered by its readers as dry and pedantic. On the other hand, the work shows in many parts a mode of presentation of certain difficult questions that is well worthy the careful study of the majority of our scientific writers who have any desire that their readers should understand what they are writing about.

The author holds that the dust and iron globules found in the depths of the sea and on the mountain-tops are of meteoric origin, — a veritable world-stuff, pervading all space, — and that by and from this stuff world-systems are evolved. He supposes that a tendency for immense amounts of these dust particles to associate about a common centre leads to the formation of nebulous clouds, which, from a

World-life; or, Comparative geology. By ALEXANDER WINCHELL, LL.D., professor of geology and paleontology in the University of Michigan. Chicago, *Griggs*, 1883. 21+642 p. 12°.

drawing-together of the scattered particles, become heated, according to the well-known law for gases.

It will not do, perhaps, to be critical here, any more than one should be of a fairy-tale, for it would destroy the charm of the illusion; and there is no reason why this speculation is not as good as, or perhaps better than, any other cosmological theory.

The book, further, contains an additional part, giving a historical account of the evolution of cosmogonic doctrines; while, as a whole, it contains very full references to the literature of the subjects discussed.

HOVEY'S MIND-READING.

THE title of this book gives no adequate idea of its contents. It is a very full account, indeed in great part a reprint, of such of the Proceedings of the English Society for psychical research as refer to thought-transference, with a few pages of introductory and concluding matter. Why this fact should not be made apparent in the title, we fail to see, as it is distinctly stated in the body of the work, and is evident on every page. The title will naturally suggest to the reader an original discussion of the history or philosophy of the subject, which the book does not pretend to give him. None the less, however, must we thank the author for presenting to the American reader so complete an account of what is really important and interesting in the volumes issued by the society referred to. He has wisely omitted every thing not pertaining to the special subject of mind-reading and telepathy. The matter pertaining to this subject is presented so fully and so faithfully, that it leaves little for the reviewer to say of the general character of the contents of the book.

What are really original, are the author's own discussions in the first and last chapters. These discussions are, we regret to say, of a nature rather to cast discredit upon the whole subject, in the minds of the closest thinkers, than to throw light upon it. The author wholly mistakes the point at issue between the believers and unbelievers in psychic force. He joins the great army of hobby-riders by holding up to ridicule or disapprobation certain real or supposed men who in the past have opposed, on scientific grounds, views which afterward turned out to be correct. This is just what every man does who has an engine to run without fuel, or a patent gun which is to destroy the largest armored ship. Mr. Hovey represents those who differ from him as men who pronounce untrue that which they cannot explain; and all the way through he imagines himself talking about people who deny his facts. Now, there are no such people worth talking about, and there is no question of fact at issue. The real state of the case is, that he has a theory for explaining admitted facts, and the only men he has to oppose are those who do not believe that he has established his theory. The admitted facts are certain phenomena known as mind-reading, and certain acts of copying drawings by a blindfolded person not in contact with any other person. The contested theory is that these facts prove the transfer of thought from mind to mind without the intervention of any physical agency. Those who refuse to accept this theory may or may not have a theory of their own: it is not at all incumbent on them to form one. They may say that they meet with phenomena which they cannot explain, every day of their lives, and that this is amongst them. The psychic societies were organized for the express purpose of investigating the subject, and finding out what theory, if any, was the correct one. If there were not some question as to how the phenomena should be explained, there would be little occasion for a psychical society.

Mind-reading and beyond. By WILLIAM A. HOVEY. Boston, *Lee & Shepard,* 1885.

TEXT-BOOKS IN CHEMISTRY AND MINERALOGY.

THE lecture-notes on general chemistry, by Dr. J. T. Stoddard, are, as the title indicates, merely an outline which should be the basis of a student's notes in a course of experimental lectures. A few general principles of the science are given briefly, and then follow statements of the properties, uses, history, method of preparation, and occurrence, of the commonest of the non-metals and their compounds. The appendix contains some tables and hints as to the methods of chemical calculation. From its briefness, the book can be of little value except as a suggestion of some elementary facts which the beginner should learn; and its use as an outline for the basis of a

Outlines of lecture-notes on general chemistry. Part i, The non-metals. By J. T. STODDARD. Northampton, *Gazette publishing company,* 1884. 84 p. 8°.

An outline of qualitative analysis for beginners. By J. T. STODDARD. Northampton, *Gazette printing company,* 1883. 4+54 p. 8°.

Systematic mineral record, with a synopsis of terms and chemical reactions used in describing minerals. By E. M. SHEPARD. New York, *Barnes,* 1884. 26 p. 8°.

student's notes will be confined to institutions where lectures on chemistry are not extensive. The book, describing only a few of the commoner and well-known compounds, is for the most part accurate. Dr. Stoddard has divided the elements into metals and non-metals, according to their periodic functions, placing bismuth, tin, antimony, and arsenic among the latter. We think it simpler and less confusing to the student if only the elements which have no basic properties are included among the non-metals. According to Dr. Stoddard's division, we see no reason why lead should not be classed as a non-metal.

The general arrangement of the qualitative analysis, by the same author, differs but little from that of other manuals. There is a close resemblance to the form of the 'lecture-notes' on the same subject by Prof. Henry B. Hill; the difference, however, in point of clearness and conciseness, not being in favor of the 'outline.' A small manual of qualitative analysis should be of such arrangement that it may be used on the laboratory-desk; and the method of regular analysis should be given in a continuous form. The methods described for the basic analysis are not always those which we have found to give the best results in the average student's hands; and the reactions given for the detection of the acids are decidedly meagre. We see nothing in the book that is new, or of any advantage over the manuals of qualitative analysis now in use.

The systematic mineral record, by Prof. E. M. Shepard, is intended to accompany any text-book of mineralogy, and will be of great help to the student in the systematic examination of minerals. Its chief feature is the extremely clear and minute explanation of the various physical and optical characteristics which enable one to determine the nature of the specimen; and the definitions are illustrated by examples of well-marked types.

NOTES AND NEWS.

DR. BENJAMIN APTHORP GOULD is to return to this country very soon from South America, where he has recently completed the observations upon which he has been engaged for so long a time at the observatory of Cordoba. His fellow-citizens of Boston propose to give him a reception and a dinner on his return.

— The British steamship Venetian, Capt. Traut, reports that on March 22, at seven P.M., in 43° north, 51° west, the sea was very much agitated, and breaking in all directions; that this condition lasted half an hour, and could not have been caused by the changes in the wind. It had the appearance of a very heavy tide race.

— A number of electrical storms are reported by vessels in the North Atlantic from March 9 to 13, and at various points off the coast from Cape Hatteras to Cape Cod. St. Elmo's fire was seen in most of the cases, and many of the storms were accompanied by heavy thundering and lightning.

— The Lyceum of natural history of Williams college, Williamstown, Mass., the oldest natural-history society but one connected with any college in the country, will celebrate its fiftieth anniversary on the 24th of this month, at which a former member, Dr. W. K. Brooks of the class of 1870, now associate of Johns Hopkins university, will deliver an address. The lyceum proposes to take advantage of the occasion to raise funds to enable it to undertake expeditions to some spot, similar to those which it has undertaken in former years to Labrador, Florida, etc.

— The first number of the *American journal of archaeology* reflects much credit upon the editorial management, and warrants the expectation that it will supply a greatly needed want to the students of archeological science in all its numerous branches. For this reason we regret the more, that, in the initial number of an American journal, the topic of American archeology should be conspicuous by its absence. This, we understand, has not arisen from neglect upon the part of the editors; and arrangements have already been made to remedy it. The original articles are not numerous, but all are of undoubted merit and interest. Professor Norton revives the memory of the earliest American classical archeologist, Mr. J. J. Middleton, of the well-known South-Carolina family of that name. He was the companion of Dodwell in his studies of the Pelasgic remains in Italy, but preceded him by six years in publication. Some of his drawings were reproduced in the well-known posthumous publication of Dodwell, but no credit was given to the American scholar. Mr. Waldstein contributes the substance of an important note to his forthcoming 'Essays on the art of Phidias,' correcting the misconception as to the artistic significance of the peplos group on the eastern frieze of the Parthenon. The longest paper is by Prof. Aug. C. Merriam, a study of inscriptions found upon a collection of sepulchral vases from Alexandria, now in New York. It is most creditable to American scholarship, and a decided addition to knowledge. The managing editor, Dr. A. L. Frothingham, jun., begins a series of articles on the relative excellence of Italian and French sculpture during the thirteenth century, in a very entertaining fashion; and Mr. Marsh gives a lucid summary of a remarkable essay by Dörpfeld, which has shed a flood of light upon the origins of Doric architecture, and its relations to earlier crude brick construction. More than half the number is devoted to book-notices, summaries of the contents of the more important archeological periodicals of Europe, and news items about discoveries, and the

labors of explorers in various countries of the old world. This promises to be one of the most valuable features of the new enterprise, which we commend most heartily to the support of all who have any interest in the study of antiquity.

— The new entomological journal, published under the auspices of the Brooklyn entomological society, under the extraordinary title of *Entomologica* (*sic!*) *Americana*, has just appeared. It is of about the size and general appearance of *Papilio*, which, and the former *Bulletin* of the Brooklyn society, it supplants. It does not differ in general character from them.

— The second of the papers by Drs. Tamburini and Seppilli on their experimental investigations in hypnotism has appeared in German translation by Dr. Fränkel of Bernburg. The first half of the pamphlet is occupied by an account of experiments and facts observed, while the last half gives their deductions from the facts. The division made by Charcot, of the phenomena, into those of the lethargic, cataleptic, and somnambulistic states, is accepted, and directions given for producing each of these states; but the three conditions are not regarded as in their ultimate nature different. All three are regarded as due to hyper-excitability of the whole cerebro-spinal axis, differing among themselves only as the irritability is greater or less. One of the arguments urged in favor of this view is from the fact that an irritation which will produce at first the lethargic state, will, if intensified, produce the cataleptic, and, upon being made still more intense, the third state, or somnambulistic, characterized by a stiffening of all the muscles. The experiments seem to have been carefully made, and the pamphlet is of real value.

— Three pages of the Bryennios manuscript, reproduced by photography from the original text, and edited, with notes, by J. Rendel Harris, associate professor of New-Testament Greek and paleography in the Johns Hopkins university, are now on the point of publication. These pages include the last verses of the Epistle of Barnabas; the superscription and opening of the first Epistle of Clement; the close of the second Epistle of Clement; the first verses of The teaching of the apostles; the last verses of the Epistle of Ignatius to the Romans, etc. A few copies are offered for sale at one dollar net. The edition is strictly limited to one hundred and twenty-five copies, and orders should therefore be sent at once to the publication agency of the Johns Hopkins university, Baltimore, Md.

— The recent announcement of the suspension of a daily paper called *The dial*, published in New York during the past year, has given an impression that the monthly journal *The dial*, published in Chicago, is the one referred to. *The dial* has just closed successfully its fifth year with the April number, just issued.

— The British steamship Chicago, Capt. Jones, reports March 13, 49° 48′ north, 12° 53′ west, eight P.M., to midnight, in 50° 5′ north, 13° 48′ west, the observation of a very brilliant aurora borealis. The display extended in an arch from north-east to north-west, and from the horizon to the zenith, the whole appearing to be arranged in concentric rings of different brilliant colors. The night was so light from this cause, that a newspaper was read on deck.

— The electrical exhibition held at the observatory of Paris was opened on the 21st of March. A series of lectures is being delivered on electricity, the first being by Mr. Wolf, on the application of electricity to astronomy, and the last by Mr. Marié-Davy, on the use of electricity in prognosticating the weather. The lectures will be published.

— In the report of Professors Sedgwick and Nichols of the Massachusetts institute of technology, who were instructed by the Massachusetts board of health to investigate the subject of 'water-gas,' we find that they are averse to the general introduction of this gas for illuminating-purposes. Ordinary coal-gas contains about seven per cent of carbonic oxide, whereas water-gas contains as much as thirty per cent. This large percentage of poison in the gas would render its introduction, even under the most careful precautions, extremely dangerous to life. In an atmosphere containing one per cent of coal-gas, dogs, cats, rabbits, and pigeons were apparently able to resist the effect of the carbonic oxide almost indefinitely; while, on the other hand, with the same amount of water-gas, death from poisoning generally resulted after from five to eight hours of exposure. Coming from such a source, this report must have much weight in settling this much-vexed question.

— Dr. George H. Horn of Philadelphia was elected an honorary member of the Entomological society of France at its meeting of March 11.

— The influence the merchant may have on science by well-directed efforts is well exemplified in the career of Godeffroy, who recently died in Germany, and who was, until lately, head of the great German firm of traders to the South-Sea Islands. He was, however, says *Nature*, much more than a merchant. Besides captains and supercargoes, he sent to Micronesia, Melanesia, Polynesia, and especially to Samoa, men of science, whose duty it was to make collections and send them to Hamburg, to form there an exhaustive museum of natural history. The first whom he sent out on a mission of this kind was Dr. Graefe of Zurich, now inspector of the zoölogical station at Trieste, who went to Samoa in 1861, and, from this as a centre, visited the Fiji, Tonga, and other groups in the region. He returned to Europe after eleven years, bringing with him important collections, and he undertook the editorship of a *Journal of the Godeffroy museum*. Amongst others thus despatched to the South Seas, was a lady who spent ten years studying the botany of northern Queensland, and a Polish surgeon who lived for five years in the Marshall and Caroline Islands, then returned to Europe, returning again to the Carolines, where he is at present. A list of the men employed by Godeffroy to travel in the South Seas to study the various islands, make collections for his museum, and report to him, would embrace all nationalities, all de-

partments of study, and every portion of the southern Pacific. Eight catalogues of the museum were published between 1864 and 1881, several of them containing zoölogical and geographical monographs as well. The *Journal*, which commenced in 1871, contained not only papers on the museum and its contents, but was open to the discussion of any scientific subject connected with the South-Sea Islands. Its most important feature was formed by the papers, by specialists, on sections of the collections sent home for the museum. Fourteen parts were published in all, the most remarkable being on the fishes, which contained 140 plates and 312 illustrations. Through financial reverses, this princely merchant died poor; and no purchaser was found for his museum, which will probably be broken up.

— According to the *Auk*, the celebrated collection of birds' eggs belonging to Dr. Baldamus of Coburg, Germany, is now offered for sale. A printed catalogue of the collection has been prepared; and it appears that the collection, which is especially rich in the nests and eggs of European birds, numbers nearly two thousand species and some ten thousand specimens. It would be a valuable accession to any museum in this country.

— The electric light has found a novel use recently in the attempt to apply it for the prevention of such explosions as have lately taken place in London. An arc-light of fifty Carcels was employed on one of the police-boats of the Thames to light the Speaker's terrace or the Westminster bridge. It was found that the movements of individuals on the land, or of boats on the river, could readily be followed. As the police-boats are too small to allow of the use of dynamo-electric machines, recourse was had to primary batteries, a chloride-of-silver battery of the form invented by Skrivanow being used, which did not occupy more than a cubic foot of space.

— The governor of Indiana has appointed Maurice Thompson of Crawfordsville to be state geologist, in place of Professor John Collett, whose term expires April 26. Mr. Thompson is known only as a writer upon out-door recreations and popular science. The reason for not re-appointing Mr. Collett is not given, and, if he was to be supplanted by another, it should have been by a thoroughly competent person.

— The managers of the Indiana institution for the deaf and dumb at Indianapolis have procured cases for a museum of considerable extent. They have a very good room in their building for this purpose. The idea of object-teaching in natural science to deaf-mutes is a good one, and will undoubtedly be followed by good results.

— In the programme of prizes for award, presented at the recent annual meeting of the Académie des sciences, was included a prize of four thousand pounds, left by Bréant in 1849, and still unawarded, to be given to any one who "shall find an efficacious remedy for Asiatic cholera, or shall discover the causes of this terrible scourge." To secure this prize, it will be necessary, 1, to find a means of curing Asiatic cholera in the immense majority of cases; 2, or to indicate with absolute certainty the causes of Asiatic cholera, so that by their suppression the epidemic shall cease; 3, or to discover a certain prophylactic as infallible, for instance, as is vaccination for small-pox.

— Dr. and Mrs. Asa Gray and Dr. W. G. Farlow visited the city of Mexico on their way to southern California. They were tendered a reception by the Historical society of southern California at Los Angeles, March 16, where Dr. Gray, though suffering from a severe cold contracted at New Orleans, made a few pleasant remarks, and was followed by an address on fungi affecting fruit-trees, by Professor Farlow. The party visited San Diego, where, unfortunately, unpleasant weather prevailed: they intend visiting other points of botanical interest.

— Pasteur's system of vaccination for anthrax has been tried with triumphant success by the Indian government, acting on the advice of Mr. J. Mills, the inspector of cattle-disease for Madras. According to the official papers, ponies, donkeys, cows, bullocks, buffaloes, sheep, and guinea-pigs have all been protected by vaccination from the consequences of inoculation with virus which proved fatal to unvaccinated animals. A vaccinated pony and a buffalo were sent to a village where there was an epidemic of anthrax; and though they were herded with diseased cattle, and grazed on the same pastures, they escaped the disease. In Burmah the elephants have been vaccinated with equal success. At first the 'vaccine' was imported from France; but the uncertainty of obtaining it pure and efficacious from any one but Pasteur himself has induced the Indian government to fit up a laboratory for the manufacture and dispensing of the fluid in Bengal; and, if that is successful, other laboratories will be founded in other centres. Mr. J. H. B. Hallen was sent, some time ago, to study in Pasteur's laboratory; and the report recommends that all veterinary surgeons should go through such a course of instruction.

— The Paris industrial exhibition for 1885 will be held from July to November in the galleries of the Palais de l'industrie. It has been decided to form three foreign sections, — one for England, another for Belgium, and a third for Italy, — in order that the processes adopted by the French workmen may be fairly compared with those of the countries named.

— Some inquiries having been made of us concerning the accuracy of the times of the occurrence of the solar eclipse of March 16 for some of the principal cities of the United States, published in *Science* last Christmas, we would say that it was not designed to furnish accurate predictions for the use of astronomers, who are in the habit themselves of performing such calculations specially for their respective points of observation, but simply to give near approximations for the use of the public at large; the times of ending being given with a little less degree of exactness than those of beginning, which latter, as far as heard from, agreed with observation within the minute, and the whole believed to have answered all practical ends.

SCIENCE.

FRIDAY, APRIL 17, 1885.

COMMENT AND CRITICISM.

The publication of Prof. A. Graham Bell's final memoir upon the formation of a deaf variety of the human race shows the extent and thoroughness of his investigation, which has already led to practical results in shaping, in certain states, the public economy in regard to deaf-mutes (*Science*, v. 207). To meet the claims of our readers, we briefly recapitulate Professor Bell's course of argument. He shows, 1°, that there is a marked grouping of deaf-mutes into families, certain surnames recurring frequently, and that the proportion and number of congenitally deaf mutes has in-increased in America, therefore the cause is probably an increasing hereditary tendency; 2°, that, of the deaf-mutes who marry at the present time, not less than eighty per cent marry deaf-mutes, while, of those who married during the early half of the present century, the proportion who married deaf-mutes was much smaller; 3°, that children having deaf-mute relatives are more likely to be congenitally deaf-mute than the children of the people at large (to illustrate this fact, he gives detailed accounts of several families); 4°, that the indications derived from the study of the actual census-tables are, that the congenital deaf-mutes of the country are increasing at a greater rate than the population at large, and the deaf-mute children of deaf-mutes at a greater rate than the congenital deaf-mute population; 5°, that the intermarriage of deaf-mutes is mainly fostered by bringing the deaf-mutes together in institutions, and isolating them thereby, and by teaching them a language (of signs) the people at large do not use.

Professor Bell, therefore, regards the philanthropic efforts which have been made to ameliorate the condition of deaf-mutes as the direct cause of an increase in the number of these unfortunates. A good purpose is the father of an evil result. What a strange antithesis! How striking the important lesson it teaches us of the efficiency of the scientific spirit as a guide in practical affairs, — that spirit which obtains thorough knowledge, and follows out to the end the analysis of cause and effect! The scientific mind, in its best form, is equipped to discover, to derive from new premises their legitimate conclusion: it is reason at its maximum power. This is not the first time that the inventor of the telephone has proved the efficiency of a mind of this quality in achieving results of immediate and far-reaching importance, and added new dignity to science in the estimation not only of thoughtful persons, but also of practical-minded Americans.

The doctrine that the bodies of all the higher plants and animals are aggregations of myriads of minute, and in many respects independent, cells, had its origin some fifty years ago. Though now universally accepted by biologists as an essentially correct generalization, it has not yet become one of those scientific facts widely known to, and accepted by, the general educated public. To the 'average man,' the proposition that his body is a collection of thousands of microscopic masses of living matter, each of which lives its life in more or less harmony with the rest, but to a great extent without any reference to them, is an astounding one. He finds it nearly impossible to realize that in certain respects he is rather a nation than an individual; that his bodily life is the algebraical sum of the living and doing of hundreds of thousands of cells, much as the vitality and activity of a nation is the resultant of the actions of all its inhabitants. His physical life is to him an entity. In consequence, there is nothing which the physiolo-

gist finds it harder to make comprehensible to the laity, than that a frog, as a complete animal, may be killed by destruction of its nervous system, yet most of its organs remain alive for hours; also the fact that it is not only possible in many cases to isolate particular organs or cells, keeping them alive for study after killing the rest of the plant or animal, but that this is even necessary, if the working of any complex organism is to be really understood. This popular ignorance, like all ignorance, has evil results. Much of the disquietude which many persons now feel in regard to physiological experiment is due to the fact that they do not realize that experiments on living hearts or muscles are usually carried out on animals which, as a whole, have previously been killed by destruction of the brain.

The remarkable operation so successfully performed by Dr. William Fluhrer of New York, involving no less a difficulty than the probing of the brain-substance itself in search of an embedded bullet, and the extraction of the missile through a counter-opening in the skull opposite the point of entrance, marks a new step in surgery which is startling in its suggestiveness. It could hardly have been anticipated that so complete a recovery would follow an operation of such difficulty and danger, involving as it did the retention in the brain, for a prolonged period of time, of a rubber drainage-tube passing completely through the head from the forehead to the back of the skull. The recovery is more remarkable on account of the additional complication of a severed artery which could not be tied, and which threatened speedy death from hemorrhage. The case illustrates the value of antiseptic or aseptic treatment, as well as the possibility of removing much brain-tissue in man, with thus far relatively little damage, which had already been demonstrated for other animals, notably for the dog. This had, however, been fairly well established for man in some cases of injury, where the surgeon had hesitated to interfere very actively. An account of this remarkable case will be found on another page. While its success would appear to justify a similar procedure under like circumstances, it is still far from certain that the next case would prove so easy of operation.

LETTERS TO THE EDITOR.

Mental capacity of an infant.

Apropos of 'Acquisition in infants,' I am tempted to state the results of an experiment I made, not long since, to test the mental capacity of Helen R. H., on the day she was fifteen months old, walking actively, but speaking only half a dozen words.

With pencil and paper, and several reliable witnesses present, I sat down, and without making any signs, or allowing signs made by others, the mother and I began to give the child a series of commands, the execution of which involved an accurate knowledge of various verbs, nouns, and pronouns. The commands were given distinctly, very seldom repeated, and were obeyed very promptly, without any questioning or explanation whatever. In one hour's time sixty-one commands were obeyed by the child with absolute precision, which showed a remembrance and correct understanding of thirty-one verbs and fifty-one nouns and pronouns. The commands given were such as the following: 'Kiss your hand,' 'Make a bow,' 'Knock on the door,' 'Blow out the candle,' 'Put the basket on the pail,' 'Put the pan in the pail,' 'Bring the bell, ball, orange,' etc. The words used were such as the child had acquired a knowledge of by observation chiefly; for not one-fourth of them had ever been taught her. I will add, that, while the child is possessed of wholesome brightness and intelligence, she has never been thought precocious. W. T. H.

Nutritive value of cellulose.

In giving an account of some recent experiments upon the digestibility of cellulose by herbivorous animals (*Science*, No. 100, p. 11), the writer took occasion to point out that the conclusions which certain writers had drawn from these experiments, regarding the nutritive value of digestible cellulose, were not sustained by the facts.

The last number of the *Zeitschrift für biologie* (xxi. 67) contains a paper by W. v. Knieriem upon the utilization of cellulose in the animal organism, in which are detailed experiments upon the digestibility of cellulose, and upon its nutritive effect, which strikingly corroborate the belief above mentioned.

The method of experiment adopted is a novel one. It consisted in feeding the animals (usually rabbits) with food containing no cellulose; the necessary bulk being supplied by horn-shavings, which were usually eaten freely, and which, as special experiments showed, were entirely unacted upon in the alimentary canal. After all the cellulose of the previous feeding had thus been removed from the animal, either a fodder containing a known amount of cellulose, or some more or less pure form of cellulose itself, was introduced into the ration. The solid excrements were collected and analyzed in the usual way, and, by means of a return to the original cellulose-free ration, all the indigestible cellulose was finally eliminated from the body.

The digestion experiments offer nothing of special interest in this connection, and we pass at once to the experiments upon the nutritive value of the digested cellulose. These were so arranged as to compare the effect of the latter with that of an equal weight of sugar in two respects: 1°, as to its influence upon the proteid metabolism of the body; and, 2°, as to its influence upon the gain or loss of fat.

The influence of carbhydrates in the food, as is well known, is to decrease the proteid metabolism, as is shown by the diminished excretion of nitrogen in the urine. In v. Knieriem's experiments, 22 grams of crude fibre, of which 11.02 grams were digested, decreased the proteid metabolism by 22%, while 11 grams of cane-sugar decreased it 15.3%: in other words, the digestible crude fibre showed itself more effective in this respect than an equal weight of sugar.

As regards the gain or loss of fat, the advantage is on the side of the sugar; the latter diminishing the daily loss from the body by 2.5 grams, while the cellulose decreased it by 1.7 grams.

These are the results of a single experiment, and, as regards exact numerical values, are of course subject to correction by future investigations. They certainly show, however, that the nutritive value of cellulose is by no means insignificant, and probably not very much below that of other carbhydrates. If, as in the former article, we assume that the heat evolved by the fermentation of the cellulose in the alimentary canal is of use to the organism, then the sole loss by the fermentation is the latent energy carried off in the marsh-gas evolved. In that paper the amount of that loss was estimated on the basis of Henneberg and Stohmann's determinations of the amount of marsh-gas excreted in their respiration experiments. If, instead of this, the amount of marsh-gas evolved in the fermentation of one gram of cellulose be made the basis of the calculation, a somewhat lower value for the cellulose results. According to Tappeiner, one gram of cellulose yields 0.335 grams CO_2, 0.047 grams CH_4, and 0.618 grams of organic acids. One gram of cellulose yields 4,452 cal.; 0.047 grams CH_4, 614 cal.: leaving 3,838 cal. to represent the available heat-value of the cellulose. One gram of cane-sugar yields 4,173 cal.; one gram of starch, 4,479 cal.: consequently, if our fundamental assumption is correct, the value of one gram of cellulose is about 92% of that of cane-sugar, and about 86% of that of starch. These results agree well with those of v. Knieriem's experiments; and the two together appear to justify the conclusion, previously stated, that the nutritive value of cellulose is not greatly inferior to that of other carbhydrates.

H. P. Armsby.

The naval observatory publications.

Referring to your criticism in *Science* for April 3, on the delay in printing annual volumes of 'Astronomical and meteorological observations' made at the U. S. naval observatory, I am glad to be able to say that the cause for complaint in this direction has been, at least temporarily, removed; and in future we hope to have our volumes printed as fast as the limited number of computers will permit the proof-sheets to be sent to the printer.

During the closing days of congress, the following resolution was introduced and concurred in: "That the annual volume of the 'Astronomical and meteorological observations' of the naval observatory for the years 1881 and 1882 be printed, and that 2,000 additional copies of each volume be printed, of which 400 copies will be for the use of the senate, 800 for the use of the house, and 800 for the use of the navy department, or for sale at the cost of paper and printing."

The manuscript sheets of the volume for 1881 are now in the hands of the printer, to be followed immediately by those for 1882; so that both of these volumes will be distributed this year, and it is hoped that we will continue to be able to have (as you very pertinently suggest) all annual volumes printed independently of the regular appropriation for the navy department.

Allan D. Brown,
Commander, U. S. navy.

U. S. naval observatory, Washington, D.C., April 6.

An attempt to photograph the corona.

Mr. Pickering's interesting experiments described in *Science* for April 3 would seem to be practically conclusive as to the unreality of the coronal forms which appear upon the plates of Dr. Huggins and Mr. Woods, if it were evident that he had observed all the conditions which they indicate as essential.

His letter, however, is silent in respect to one important point. It is not stated whether or not the plates were 'backed' with any light-absorbing substance, in order to prevent the so-called 'halation' produced by reflection from the back surface of the plate under a strong light. The English observers insist urgently upon the necessity of this precaution, and use for the purpose, I believe, a coat of asphalt varnish, colored with Brunswick black. It is possible that even this expedient would not wholly prevent a streaky scattering of light at the edge of the sun's image, because minute particles of foreign matter embedded in the glass itself would have their influence; but it is obvious, that, if the experiment was tried without the precaution, it cannot be looked upon as any way decisive.

Perhaps Mr. Pickering would kindly supplement his communication by a brief statement regarding this point.

C. A. Young.

Princeton, N.J., April 8.

In reply to Professor Young's communication, I would say that the precaution to which he refers was carefully attended to, and that all the plates employed were backed the day before the eclipse with asphalt varnish. It would be very interesting to know how far the corona, as photographed by Dr. Huggins, extends from the sun: for a very long exposure would probably mask the real phenomenon; one that was very short would be insufficient to obtain an impression of it. My exposures were so timed, that, by a long development, the darkening could be traced to a distance of .8 of the sun's diameter, while, with a short development, the darkening only reached to .2. But in no case could any particular rays be identified in the different photographs.

Wm. H. Pickering.

Sir William Thomson's Molecular dynamics.

As it is possible that some of your readers may have obtained copies of the papyrograph report of my lectures on molecular dynamics, delivered at Baltimore during October, 1884, I should be obliged by your giving publicity to the following corrections: —

P. 34, lines 18 and 19, delete 'We may call it a dynamax but not a paradox.' I have no recollection of, nor can I imagine, what the word was that I suggested as more logical than 'paradox.'

P. 59, line 14, for 'distortional' substitute 'condensational.'

P. 296, in the two expressions for ψ, given in equation (17), insert 'tan i' before '$\frac{(\mu^2-1)^2}{\mu^2+1}$;' also in the expression for 'tan e' and 'tan e_1,' of equation (20), insert 'tan i' before '$\frac{(\mu^2-1)^2}{\mu^2+1}$.' The formula from which these expressions are deduced is correctly given at the foot of p. 295.

P. 296, in line 13 from top of the page, and in the left-hand members of equations (20) and (21), for 'w' and 'w_1,' read 'ω' and 'ω_1' respectively.

WILLIAM THOMSON.

The university, Glasgow, March 26.

The cold weather of February and March.

During the past two months the cold weather has been of unusually long duration; so much so, that in many places in and about the city the water and gas pipes, which are placed about four feet under the ground, have been frozen. This being the case, I have thought that it would be interesting to see, from the records of Draper's continuous self-recording thermometer of this observatory, what was the difference in the duration of the cold in this year, as compared with last. The following table shows the comparison of temperature every ten degrees, from the lowest to the highest, for the years 1884 and 1885, during the months of February and March, and also the number of times or hours the temperature was below or above 30°, which has been taken as a temperature of neither freezing nor thawing.

Degrees.	1884. Hours' duration.		1885. Hours' duration.	
	February.	March.	February.	March.
−10 to 0	–	–	2	–
0 to 10	14	11	44	5
10 to 20	30	71	191	139
20 to 30	97	105	250	157
Hours of cold	141	187	487	301
30 to 40	375	223	155	362
40 to 50	152	225	30	62
50 to 60	28	102	–	19
60 to 70	–	7	–	–
Hours of heat	555	557	185	443

Hours of cold, in 1885, for February	487	
Hours of cold, in 1885, for March	301	788
Hours of cold, in 1884, for February	141	
Hours of cold, in 1884, for March	187	328
Difference of hours of cold between the two years		460

There were therefore, during these two months, 460 hours more of cold in 1885 than in 1884.

DANIEL DRAPER, PH.D.,
Director.

CIVIL AND ASTRONOMICAL TIME.

THERE seems to be a good deal of doubt whether the recommendations of the Prime-meridian conference are going to be very generally accepted. France, and the nations under French influence, certainly will not adopt the new anti-Greenwich meridian for many years, if ever. The matter is really one of comparatively little importance; that is to say, it will make no very great practical difference to any one if different nations continue to use different meridians: still there can be no question that there would be a real and considerable convenience in the establishment of a single meridian, and consequently of a time-system, which, like our present railroad-time in the United States, would be identical as to minutes and seconds all over the earth. It is probable that the gentle pressure of this convenience will, after a while, bring about the desirable concurrence, especially as the increasing extent and rapidity of travel and communication will all the time bring out more forcibly the inconveniences of the present state of affairs, and tend to weaken mere local feeling and prejudice, which, after all, is the main obstacle at present to the universal adoption of the meridian proposed.

The recommendation that astronomers should come into agreement with other folks, and begin their day at midnight instead of the following noon, as at present, seems especially likely to fail. The Greenwich observatory, indeed, adopted the new plan on Jan. 1; but, so far as we know, no other important astronomical establishment has yet done so. Commodore Franklin, of the U. S. naval observatory, proposed to follow the example of Greenwich, and issued an order to that effect; but it excited so much opposition from certain eminent and influential astronomers, that the order was suspended before the time came for it to go into operation.

The objections of Professor Newcomb, who has formulated more fully and forcibly than any one else the reasons why the change should not be made, relate not so much to the fact that astronomers would find it inconvenient to change the date of their observations at midnight, as to the confusion that would be likely to result in the combination and comparison of observations taken before the introduc-

tion of the new system, and after it. The same sort of difficulty now exists in comparing observations made before and after the introduction of the Gregorian calendar; but in this case the discontinuity amounts to ten or eleven days, and cannot escape notice, while the discontinuity involved in the proposed system would be only twelve hours, and might easily be overlooked with most damaging consequences. This objection is undoubtedly valid and weighty. The other objections urged, as to changes needed in the ephemerides, really amount to very little. At present, one has to stop a moment to consider whether he is acting as a *civilian* or an *astronomer* when he opens the Ephemeris to look out data; and it is quite immaterial as regards the numbers given for *noon*, for instance, whether noon is called 0 h. or 12 h. As to the changes in the printing of the Ephemeris, they would involve a little extra work the first year, but nothing of any consequence.

Per contra, a considerable majority of the astronomers consulted by Commodore Franklin were of opinion that the advantage gained by abolishing the distinction between civil and astronomical reckoning would fully compensate for the admitted annoyance consequent upon the change. The number of people inconvenienced by the change would be very small, and they would be persons abundantly able to guard against mistakes such as others would be likely to make. On the other hand, the present system leads to confusion in the case of all neophytes in astronomical work: indeed, pretty good astronomers are sometimes caught napping when they look into the almanac for forenoon data; and in publishing observations it is often necessary, and always wise, to state whether civil or astronomical reckoning is used. Of course, the change in itself considered is of very little importance; but it does seem rather unfortunate that the recommendations of the Washington conference should fail, to begin with, at the Washington observatory, and the effect will undoubtedly be to postpone the acceptance of the whole system of proposed reforms.

THE SCIENTIFIC RESULTS OF THE LADY FRANKLIN BAY EXPEDITION.[1]

THE general interest in the scientific work of most polar expeditions has been seriously affected by the long delay which necessarily occurs in the publication of the records and results. With the permission and concurrence of Gen. W. B. Hazen, chief signal-officer, I take pleasure in giving, as far as I can at present, a brief summary of some of the scientific results of the Lady Franklin Bay expedition.

Hourly magnetic declination observations for thirty-two days on which they were made previous to July 1, 1882, were reduced at Fort Conger. The mean declination thus obtained was 100° 12′ west, being 1° 32′ less than the result deduced from the observations of the English expedition of 1875–76. The maximum easterly deflection occurred at 2 A.M., local time (7 A.M., Gottingen mean time), and the maximum westerly deflection at 12 M. A primary maximum at 4 P.M., most probably was due to disturbances. These deflections are from one to two hours later than those obtained from the observations of Lieuts. Archer and Fulford, R.N., in 1875–76; but it is possible that the observations for the complete year, which are now in the hands of Assistant Charles Schott of the U. S. coast and geodetic survey for reduction, may give other results. The hours, however, agree with those determined for Van Rensselaer harbor by Mr. Schott, in the discussion of Kane's observations. The absolute range of the English observations was 8°; and the greatest daily change, 5° 9.4′. From 8.35 A.M. (Gottingen mean time), Nov. 16, 1883, to 10.30 P.M., Nov. 18, the absolute range as observed was 20° 28.2′, — from 113° 19.8′ west, to 92° 51.6′ west. These times and figures are given as of more than common interest in connection with the great magnetic storm of November, 1883. The changes at Conger were much greater, it will be observed, than at Godthaab, Greenland, where, Paulsen says, on Nov. 17, 1883, from 2 A.M. until noon, the declination had varied 4° 44′ to the east, and later about 5° to the west; so that the variations for the day reached 9.5°.

The following table of monthly means has

[1] The accompanying picture represents Fort Conger as it was photographed by Sergeant George W. Rice, in March, 1882, the print from which it was taken being one of the few that were brought safely home by the Greely party. The high ground at the north-west of the station is seen at the left. The picture represents the principal building occupied. There were three other small structures, astronomical and magnetic observatories, and an instrument-shelter, the wires seen at the right running to the astronomical observatory.

THE STATION OF THE GREELY PARTY AT LADY FRANKLIN BAY.

been compiled from three years' observations,—1875–76 and 1881–83.

	Barometer to sea.	Temperature.	Rainfall, inches (two years only).
January	29.756	−38.3°	0.42
February	0.779	−40.1°	0.13
March	0 962	−28.3°	0.45
April	30.175	−13.6°	0.17
May	0.021	+14.1°	0.40
June	29.852	32.7°	0.18
July	0.725	37.1°	0.66
August	0.787	33.8°	0.38
September	0.749	15.8°	0.35
October	0.925	− 8.9°	0.24
November	0.971	−23.3°	0.20
December	0.830	−28.1°	0.30
Year	29.878	− 3.9°	3.88

The barometrical observations show atmospheric changes which I believe are common to the region within the arctic circle, north of America at least. The marked maximum pressure in April gives way rapidly to the principal minimum in July; to be followed by a secondary maximum in November, and a less marked minimum in January or February.

The hourly barometric observations are of special interest as tending towards a final solution of the question whether or not the regular diurnal variation observed in lower latitudes also occurs near the poles. Buchan, noting the fact that the range at St. Petersburg and Bosukop is but about .012 of an inch, remarks, "And in still higher latitudes, at that period of the year when there is no alternation of day and night, the diurnal variation probably does not occur."

The first year's observations at Fort Conger satisfied me that such diurnal variation does occur in very high latitudes, and my opinion was confirmed by subsequent observations. Reductions made several months before the station was abandoned, from nearly five hundred days' continuous observation, showed a range of .0099 of an inch. The primary maximum occurs at 5 A.M., Washington mean time (which is 53 minutes slower than local time), followed by the primary minimum at 1 P.M. The secondary maximum and minimum took place at 6 P.M. and midnight respectively. To determine whether the presence or absence of the sun affected the fluctuation, I calculated separately the means of the days of continual darkness and continuous sunlight up to May 1, 1883. The diurnal fluctuation was substantially the same, and the critical hours were identical in the arctic night and in the polar day.

The absolute range of the barometer observed was 2.032 inches, — from 31, April 9, 1882, to 28.968, Feb. 19, 1883. It is interesting to note that the minimum pressure for the year 1882–83 at Godthaab and in Spitzbergen occurred respectively one day earlier and three days later than at Fort Conger. The barometer at Godthaab touched the unusually low point of 27.89.

The annual mean temperature (−3.9°) is the lowest on the globe, being 1.4° below that deduced for Van Rensselaer harbor from Kane's observations. It quite disposes of the theories of a warmer climate as the pole is approached. The maximum mean at Fort Conger agrees with that of other arctic stations in general, occurring in July; and the monthly mean gradually declines to the minimum in February. This month, I think, is generally the coldest at arctic stations; and, when the lowest mean has been noted in January (or occasionally in March), I believe a series of years would change it to February. The lowest monthly mean (−46.5°) for February, 1882, must give way, however, to that at Werchojansk (on the Lena), from which the following means are reported: December, −50.3°; January, −56°; and February, — 53°. The highest monthly mean was that of July, 1883, 37.2°. The absolute range of temperature was 115.1°,— from −62.1°, Feb. 3, 1882, to +53°, June 30, 1882.

The amount of rain and melted snow was 3.95 inches the first, and 3.82 the second year, irregularly distributed throughout the year. This small amount of precipitation may explain the non-glaciation of the adjacent country. I believe the precipitation in the interior to be less than at Fort Conger.

The wind resultants are as follows: first year, S. 61.4° E. 7594 miles; second year, S. 67.3° E. 6437 miles. The wind was more southerly from 2 to 4 P.M., inclusive, than at other hours during the first year, and from 11 A.M. to 2 P.M. the second year.

The mean tidal establishment was determined by me at Fort Conger from two years' observations on a fixed gauge, as follows: —

High water (1314 tides)	11 h. 33.9 m.
Low water (1314 tides)	17 h. 45.7 m.

Complete series of high and low waters for two years, with regular hourly readings of the tide for one year at Fort Conger, have been placed in the hands of Mr. Schott. These observations, with supplementary simultaneous readings at Capes Sumner, Beechy, Craycroft, Leebi, and at Repulse harbor, added to Bessel's and Nares' observations, will, I trust, enable

tidal experts to determine the co-tidal curves for Lincoln Sea, and Robesen and Kennedy channels.

The temperature of the surface sea-water was carefully observed from October, 1882, to June, 1883. The temperature fell steadily from a mean of 29.2° in October, to 29° in December, and then rose steadily to 29.4° in June. The ebbing tide (to the north) was from 0.1° to 0.2° colder than the flowing tide, and its mean for December was 28.9°.

The sounding of 133 fathoms and no bottom, midway between Capes May and Britannia, is significant of a different ocean along the north coast of Greenland, from the shallow sea north of Asia, North America, and Grinnell Land.

Forty-eight swings, with accompanying time observations, were made with a pendulum furnished by the U. S. coast and geodetic survey. The observations are now in the hands of Assistant Charles S. Peirce for reduction and comparison. I regret that continued mental and physical weakness have prevented more careful and systematic treatment of these subjects. This summary is now presented, as the immediate future promises no better results from my hands. A. W. GREELY, *U. S. army.*

FOOTPRINTS IN THE ROCKS OF COLORADO.

FROM a few tracks and signs, an Indian is said to have inferred that at noon there had passed by a white man, lame in the left foot, blind in the right eye, dressed in gray, and with a double-barrelled gun and a black dog. With no attempt to rival the aborigines, nor to name and classify, it is interesting to notice some features of the footprints on four slabs from St. Vrain Creek, Col., — the only vestiges of animal life thus far reported from the immense beds of triassic sandstones in the eastern Rocky Mountains. Three of the slabs are in the museum of Iowa college, Grinnell, Io.: the other, No. 2, has been sent to the national museum.

Slab No. 1, represented in the figure, with two of the tracks on a larger scale, is somewhat like the rare horseshoe forms found in Europe and in the Connecticut valley, in rocks of the same age. No hoofed animal is supposed to have existed at so early a period. The shape has been attributed to a membrane beneath claws, in this case a firm, flat pad, if that be the explanation, and semicircular within as well as exteriorly. In the three forward tracks, the fore and hind feet coincided, making one impression. In four of the remaining tracks, the smaller fore-feet show a crescent that coalesces with that of the hind-foot. There is a rough, *broken*, irregular bulging of the rock in and behind the hollow of the foot, dying away backward into the surface. The great amount of this would suggest that the animal was ascending a wet slope.

The appearance of slab No. 3 is so like No. 2 that they were probably one continuous series. As seen in the figure, the larger impression of the hind-foot mostly touches, and once or twice somewhat overlaps, that of the fore-foot, which is evidently such because its position varies relatively to the former. It has a wide angle from the line of progression. In the last (uppermost) left feet, the fore-foot repeats its print, though at first glance it looks like a jointed toe. All the impressions are simple ovals (ellipses), deepest in the centre; and several, as in the larger separate figure, have a shallow ear-shaped impression on the inner forward border, which, in two, shows slight lengthwise wrinkles. The left-side tracks are less perfect, as if the right feet pressed on a lower, wetter part of the ancient beach.

In No. 3 there was an inch space between the heels in passing each other; in No. 1, little

SLAB NO. 1.

Average stride, $8\frac{1}{2}$ inches; width of trackway, $4\frac{1}{4}$ inches. Scale, 1-12.

or none. The animals must therefore have had an erect habit, not the dragging movement, with horizontally extended legs, of ordinary reptiles, if reptiles they were.

Slab No. 4 has nine pairs of hind-foot tracks, with the fore-feet sometimes coinciding, and elsewhere separated at considerable distances. They are in relief, that is, on the under side

Fifth right feet.
Scale $\frac{1}{3}$.

SLAB NO. 3.
Average stride, $8\frac{1}{4}$ inches; width of trackway, $4\frac{1}{2}$ inches.
Scale, 1-12.

of the layer, and resemble Nos. 2 and 3, but smaller; and the stride is two inches less.

Thorough search was made among the vast quantities of waste stone in the main quarries, and also in those of Stone Cañon adjoining, as well as in the streets of Denver, where these red quartzitic sandstones are largely used for flagging. The scarcity of the tracks is emphasized by the abundance of raindrop impressions. There were also many irregular stellate moulds, left by some crystallization, which a quarryman mistook for tracks.

H. W. Parker.

SUCCESSFUL EXTRACTION OF A BULLET FROM THE BRAIN.

The *New-York medical journal* of March 28 gives an account of an interesting surgical operation recently performed in New York, from which we condense the following statement: —

On the 24th of January, 1884, a healthy young man, Bruno Knorr, nineteen years old, was admitted into one of the wards at Bellevue hospital, suffering from a pistol-shot wound penetrating the brain through the centre of the forehead. The patient was semi-unconscious, and when aroused was irritable, and in answer to all questions simply grunted 'ja.' It was thus impossible to ascertain the circumstances of the occurrence of the injury. It has since, however, been learned from the patient, that, while lying upon his back, he shot himself with a pistol held in contact with his forehead. There was complete loss of motion without loss of sensation on the right side of the body, below the head. There was increased sensitiveness on the left side, which was very marked upon the left side of the scalp near the ear.

Preparatory to the operation, the patient's scalp was shaved. He was then etherized. A flap of gutta-percha tissue was fastened to his forehead to protect his eyes from the antiseptic solution used.

The bullet-hole in the skull, which was about half an inch in diameter, was then enlarged with a Ronguer forceps; but during the process a small clot was disturbed, which gave rise to arterial bleeding from beneath a depressed fragment of the skull whose sharp, convex edge had been driven into the brain. Upon the removal of this fragment the arterial hemorrhage was alarmingly profuse, and it became evident that the patient would speedily bleed to death unless it could be stopped.

After many unsuccessful attempts, Dr. Fluhrer succeeded in catching the artery with a Langenbeck's artery-forceps, and, while he held the instrument, an assistant attempted to tie the vessel. Unfortunately, during the process the delicate artery was torn, and it was found impossible to reach the remaining portion without removing another piece of the skull which covered it. In the mean time, the hemorrhage was so great as to threaten the patient's life. This was partially arrested by an assistant, who passed his finger through the opening in the skull, and compressed the artery against the brain, while Dr. Fluhrer removed a disk of bone sufficiently large to enable the artery to be reached with a Pean's forceps. With the aid of two pairs of dissecting-forceps, he succeeded in passing a silk ligature around the artery, and tying it. Upon the removal of the Pean's forceps, however, the pulsations of the artery and brain loosened and threw off the ligature, so that the bleeding became as profuse as before. The vessel from which the blood flowed was found to have been severed near its junction with a large artery, which Dr. Fluhrer now seized below the point of bifurcation. He saw clearly that the short branch could not be tied; and fearing that the slightest movement of the patient's head might tear the delicate vessel from the forceps, and cause an inevitably fatal hemorrhage, he transferred the artery to the grasp of the short and light clamp shown in fig. 1, which could lie in the wound with-

Fig. 1. — Small artery clamp, actual size.

out risk of detachment. No further attempt was made to ligature the artery, and the metallic clamp was left in the brain for many days. Two and a half hours had been spent in reaching this stage of the operation. Having arrested the hemorrhage, Dr.

Fluhrer proceeded with his attempt to follow the course of the ball with the probe. The patient's head was now placed in such a position that the presumed track of the ball was perpendicular to the horizon. A perfectly straight Nelaton's probe was then passed perpendicularly into the brain to a depth of about six inches, when a soft resistance was felt, which no effort was made to overcome. The depth to which the probe had passed supported the hypothesis that the bullet had gone completely through the brain, and had struck the opposite side of the skull. In order to ascertain the probable locality of the impact, the probe was left standing in the brain, and the point on the back of the head was noted at which the probe would emerge if projected through the brain. This was presumed to be the point of interior impact. An opening was then made in the skull at a point three-quarters of an inch lower down in the supposed plane of the path of the bullet, and the membrane covering the brain was carefully slit so as to admit the end of the index-finger. A resistance was felt in the brain at the depth of about half an inch, which was believed to be the bullet. Instead of exploring this resistance with a needle, it was decided to continue the opening in the skull upwards until the point of impact was reached, and then extract the bullet through the opening it had itself made. This was successfully accomplished.

The patient's head was then placed in the same position as at first, and the probe was again introduced through the opening in the forehead, and, as before, it encountered a soft resistance at about the depth of six inches. Leaving the probe standing upright, the finger was carefully introduced into the brain from the opening at the back of the skull, and the discovery was made that the obstruction to the passage of the probe was due to the *dura mater* alone. This was remedied by slitting the membrane, and the end of the probe then appeared at the opening in the back of the head. A small-sized rubber tube was attached to this end, and drawn through the brain by the removal of the probe. The tube was left in the brain for drainage-purposes, and the patient's wounds were then dressed.

The operation, which had been conducted throughout with antiseptic precautions, was completed in about four hours from its commencement, the greater portion of the time having been spent in stopping the cerebral hemorrhage.

In addition to Dr. William F. Fluhrer, the following members of the house staff were present, and witnessed the operation: Drs. R. T. Morris, J. R. Conway, jun., W. W. French, J. H. Woodward, H. N. Williams, P. Oppenheimer, H. S. Wildman, H. Herman, H. Biggs, E. Hurd, C. F. Roberts, and W. G. Rutherford.

On May 22, 1884, Dr. Fluhrer exhibited Knorr at Bellevue hospital to a number of physicians. He was then, so far as could be judged, in perfect health. Apart from the scars upon the patient, the only abnormality discoverable was a limitation of the visual field for green and red, observed by Dr. W. F. Mittendorf. Inasmuch as this feature was common to both eyes, it is questionable whether it was caused by the injury.

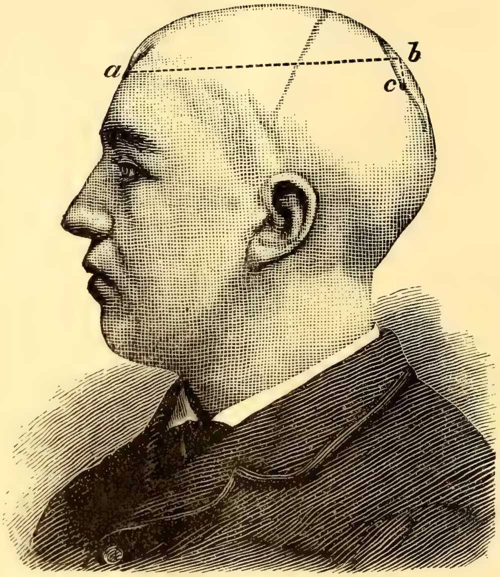


FIG. 2.

The engraving, fig. 2, is from a photograph of the patient taken at that time. The light line marks the position of the fissure of Rolando. The bullet entered at the centre of the forehead, an inch and a quarter above the upper level of the eyebrows: it passed in a straight line through the brain, from *a* to *b*, and was deflected to *c*, where it lodged.

The patient left the hospital, where he had for a long time been retained simply for observation, on June 30, 1884, and in a month went back to work at his old employment in a butcher's shop. He remained at work during the exceptionally hot weather in the early part of September.

On Sept. 12, between twelve and one o'clock in the morning, Knorr received a heavy blow in the anterior scar from the elbow of the man with whom he was sleeping. Knorr states that he suffered intense pain in the head for half an hour, when it died away, and he fell asleep again. He awoke at about four o'clock, and noticed, with wonder, his right forearm beginning to flex upon the arm. He tried to hold it down with his left hand, but failed. Then his right leg was drawn up. Then his left upper and lower extremities respectively became affected in the same manner. He remembered being asked what was the matter, and that he could not speak, but screamed, and then lost consciousness. The convulsive movements were so energetic, that the patient was thrown from his bed upon the floor; nevertheless, he was able to return to work the same day.

On Oct. 1, while delivering a parcel at the house of a customer, he was seized with a slight rigidity, followed by a short convulsive movement of the

limbs, and a momentary loss of consciousness, but did not fall.

He has now had no recurrence of convulsions, or other epileptic symptoms whatever, for a period of nearly six months. When he began working after his discharge from the hospital, he noticed, in trying to keep in mind the orders for deliveries to customers, that his memory was not so good as before the injury. He now follows the same occupation, and performs the same duties in it, as before he was shot. He feels perfectly well, and, by the test mentioned above, is sure that his memory is constantly growing more retentive.

THE DEBATE ON VIVISECTION AT OXFORD.[1]

In our last issue we gave a brief notice of the proceedings in an overflowing convocation at Oxford, which resulted in a majority of 412 votes to 244 in favor of the decree promulgated by the Hebdomadal council. This decree had only an indirect bearing upon the question of vivisection; but as it was made an occasion for a fresh, and, let us hope, a final, trial of strength between the scientific and anti-scientific forces of the university, it is desirable to furnish our readers with a somewhat more full account of what took place than we had time to print last week. Seeing that the debate had clearly been organized with no small amount of care on the side of the anti-vivisectionists, and that the ablest as well as the most authoritative speakers in Oxford who could support their cause were put forward, we may regard the arguments which were adduced as a fair example of the best that can be said against vivisection by cultured thought and cultured speech. We will therefore confine our remarks to what was said on this side of the question.

Regarded as a piece of oratory, the speech of Canon Liddon was, in our opinion, perfect; and the effect of what we may term an artistic eloquence was enhanced by the appearance and costume of the speaker, as well as by the appropriateness of his surroundings in the densely crowded Sheldonian theatre. But when we look from the manner to the matter of his speech, we are unable to bestow such unqualified praise, although we confess that even here we were agreeably surprised by the judicious moderation of its tone. His views, briefly stated, were, that so long as we hold it morally lawful to kill animals for food, or otherwise to use them for our own purposes, so long must we in consistency hold, that, under certain circumstances, it is morally lawful to inflict pain upon animals for the benefit of man. The special case of vivisection does not differ in principle from other cases where pain is thus inflicted; but it ought to be qualified by three conditions: it should be resorted to as rarely as possible, it should be guarded against the instinct of cruelty, and it should be so used as not to demoralize spectators. With all this, every physiologist would of course agree. The canon, however, proceeded to talk what, in the strictest meaning of the word, must be termed nonsense, when he affirmed that physiology might be 'divorced' from vivisection. That this statement has gained currency among the anti-vivisectionists does not alter its essentially unreasonable character. It is perfectly true that in many departments of physiological research vivisection is not required; but it is no less true that in many other departments vivisection is an unconditional necessity. This fact, one would think, admits of being rendered obvious to any impartial mind, howsoever ignorant of physiological science; for, if this science consists in the study of vital processes going on in the living organism, does it not obviously follow that some of them can only be studied while actually taking place? How, for example, would it be possible to gain any knowledge of the electrical and other changes which occur in a gland during the process of secretion, except by estimating these changes during the act of secretion? The gratuitous information which physiologists receive from technically ignorant sources, touching the nature and the value of their own methods, can only suggest the presumption of inexperienced youth when venturing to instruct a maternal grandparent in the practical aspects of oölogy.

It appears that Professor Burdon-Sanderson had pledged himself not to exhibit vivisections to his class for the purposes of teaching, and for this concession to the unreasoning prejudice of his opponents he received a warm expression of gratitude from Canon Liddon. Probably enough, under the circumstances in which he is placed, the concession is a prudent one; but that it merited the eulogium which was bestowed upon it by Canon Liddon on moral grounds, no man of common sense could very well suppose. Demonstrations on the living subject, if performed in a class-room at Oxford, would of course be always performed on animals under the influence of anaesthetics; and therefore the 'demoralizing' effects upon the minds of young men, which Canon Liddon takes to have been averted by Professor Sanderson's concession, can only be understood to consist in disregarding the mawkish sentimentality which cannot stand the sight of a painless dissection. This kind of 'morality' may be regarded as tolerable in a girl: in a man it is not tolerable, and deserves the same kind of pitying contempt as is accorded to personal cowardice, with which it is most nearly allied.

Canon Liddon, however, regretted that Professor Sanderson had not further pledged himself to restrict his experiments *for the purposes of research* to animals kept under the influence of anaesthetics during the operations, and killed before recovering from their anaesthesia. We have no doubt that Professor Sanderson might have complied with the first of these suggestions without any serious detriment to his future researches; for, as a matter of fact, the cases in which anaesthetics interfere with the progress of an experiment, are, comparatively speaking, very rare indeed,

[1] From *Nature* of March 19.

except where the occurrence of pain forms a necessary part of the experiment; i.e., in certain researches on the functions of sensory nerves. But as all the functions of sensory nerves which require for their study the infliction of pain have already been worked out, physiology, as it now stands, does not demand the absence of anaesthetics, save in a very small percentage of operations: therefore, when pain is inflicted during an operation, it is due, as a rule, not to the exigencies of research, but to the indifference of the operator, — a fact which we think physiologists ought to be more insistent than they are in impressing upon the mind of the public.

Nevertheless, we feel persuaded that Professor Sanderson was perfectly right in not binding himself never to operate without anaesthetics: for by so doing he would have virtually conceded the principle that the suffering of an animal is too great a price at which to buy an advance of knowledge; and this, among other things, would have been to place a moral stigma upon some of the most valuable researches of the past. Besides, as was pointed out in the course of an able speech by Professor Dicey, it is not desirable that the *status* of a professor in the university should be regarded as beneath that of a gentleman; and, if it is supposed that Dr. Sanderson is not to be trusted in the latter capacity, he ought never to have been chosen to fill an Oxford chair. In short, as the representative of physiology in Oxford, Dr. Sanderson, by the nature and extent of his concession, has drawn a clear distinction between the importance of teaching and of research: he has consented to allow the teaching to suffer, if needs be; but he will not consent to yield an inch where the principles of research are concerned.

The other suggestion which was thrown out by Canon Liddon — namely, that a professor of physiology ought to pledge himself to kill every animal before it recovers from its anaesthesia — is, from every point of view, absurd. In the first place, the suggestion can only emanate from the uninformed supposition that the pain of a healing wound is considerable. But we know, from the experience of hospital practice, that even the most severe wounds are painless while healing, unless the process of healing is complicated by morbid conditions, which now admit of being wholly prevented by antiseptic methods. As a matter of fact, therefore, in our physiological laboratories, as in our surgical wards, there is at the present time but an extremely small amount of suffering to be found in connection with the healing of wounds; and no man of ordinary sense, who had ever seen the inside of either the one or the other, would have cared to make the suggestion which we are considering. But in the next place, even if this were not so, it would have been highly wrong in any professor of physiology to restrict himself to the performance of experiments the objects of which could be secured during the action of an anaesthetic. Certainly more than half the experiments which the physiologist has now to perform have reference to questions of after-effects, and this is especially the case in experiments bearing upon the problems of pathology.

The speech of the bishop of Oxford was bad, both in logic and in taste. It was bad in logic, because, in arguing for the total suppression of physiological research in Oxford, he relied upon foreign practice for his evidence of cruelty. This was essentially illogical, because it fails to distinguish between two very different things; namely, the cruelty, if any, which attaches to vivisection *per se*, and the cruelty which arises from other sources. If the state of public feeling in some foreign countries is not so sensitive as it is in our own on the matter of inflicting pain upon the lower animals, it is obviously unfair to search through the continent for instances of cruelty in connection with physiological research, and then to adduce such instances as proof of cruelty necessarily attaching to physiological research at home. We might as well argue against the use of mules in England because these animals are badly treated in Spain. As we have already said, there are now but extremely few cases possible in which the occurrence of pain is necessary for the purposes of an experiment; and therefore the proof of pain having been inflicted in any one case constitutes proof, not of the pain-giving character of vivisection in general, but of the carelessness of some operator in particular. The cruelty must belong to the individual, not to the methods; and we are not aware that any charge of cruelty has hitherto been proved against an English physiologist.

The bishop of Oxford's speech was bad in taste, because he sought, missionary-wise, to tell some anecdote of horror, which the good sense of convocation prevented him from narrating, further than that the subject of his story was to have been 'An affectionate little dog.' But as he was not able to give any reference to the scene of his tragedy, after a prolonged battle with his audience upon this somewhat necessary proof of authenticity, he was obliged to give way. His taste was perhaps still more questionable, when, in the presence of Professor Sanderson and other working physiologists, he proceeded to adduce the favorite argument that the pursuit of experimental physiology exercises a baleful influence on the moral nature. That the argument is unsound, both in principle and in fact, we need not wait to show.

The speech of Professor Freeman was rendered wholly inaudible by a general uproar, which proceeded chiefly from the side which he rose to support. We were told that this was due to the memory of the effect which was produced by his speech on the occasion of the previous vote.

Upon the whole, we think that the debate was of no little service to the cause of physiology in Oxford; and, when we consider how largely the majority of votes has grown since the first of the three divisions, we are glad to congratulate the university upon having shown so emphatically, that, not less than her sister, she is able to withstand the assaults of the two great enemies of learning, — ignorance and fanaticism.

THE ROYAL ASTRONOMICAL SOCIETY OF LONDON.

THIS society, the most important astronomical organization in existence holding frequent meetings, had its anniversary session on Feb. 13, on which occasion the principal event was the presentation of the gold medal to Dr. William Huggins for his spectroscopic researches, as already announced. The 'Monthly notice' which gives account of this meeting is usually the most interesting number for the year, and the present issue is not disappointing in this regard. The society, which was organized about the year 1820, is possessed of a good degree of wealth, aggregating considerably more than a hundred thousand dollars, of which about seventy thousand are pecuniarily remunerative. Not a small amount of the society's property is in the shape of astronomical and other instruments of precision, a catalogue of which is regularly published, and embraces this year a list of a hundred and twenty-one entries. The publications of the society have now reached the forty-fifth volume of 'Monthly notices,' and of the 'Memoirs' the forty-eighth. The second part of this latter volume is now in press, and is announced to contain Mr. Seabroke's fourth catalogue of micrometric measures of double stars, Professor Pritchard's determination of the relative proper motion of forty stars in the Pleiades, Mr. Knobel's observations of Mars in 1884, and two memoirs relative to the moon, — the one by Mr. Neison on the corrections required by Hansen's 'Tables,' and the other by Gogou on an inequality of long-period in its motion.

The council of the society record the loss by death, during the year, of fifteen fellows and one associate: an exceptional number of these are men of wide reputation, and the obituary records are exceptionally well written. We note only Henry George Bohn, John Henry Dallmeyer, Isaac Todhunter, Francis Diedrich Wackerbarth, Ernst Friedrich Wilhelm Klinkerfues, Marian Kowalski, and Johann Friedrich Julius Schmidt. In general, the 'Proceedings of observatories' are not more interesting than formerly; and, of the twenty-one institutions reported, a small number appear to be gradually fossilizing, while at two or three an extraordinary degree of activity is evinced. American astronomers will find slender cause for complaining at the council's "Notes on some points connected with the progress of astronomy during the past year;" for about one-half of the section of twenty-seven pages devoted to this history is occupied with the work of Americans in the advancement of this science. The important 'points' commented upon are Professor Newcomb's researches in mathematical astronomy, Professor Safford's investigation of Greenwich planetary observations, star catalogues by Dr. Gould and Dr. Grant, Dr. Backlund's investigation of the motion of Encke's comet, Dembowski's measures of double stars, Professor Pickering's work with the meridian photometer, Dr. Huggins's photography of the solar corona without an eclipse, Professor Langley's researches in atmospheric absorption, and the conclusions of the International prime-meridian conference.

At the conclusion of the anniversary meeting, Mr. Edwin Dunkin was re-elected president of the society; and Professor Adams, Professor Cayley, Dr. De la Rue, and Mr. Stone were elected vice-presidents.

JAMES CLERK MAXWELL.

THIS abridged volume will be welcomed with great pleasure by all who have enjoyed the larger work, for it puts into one's hands a *vade mecum*. The life of Maxwell is worth pondering upon; and it is a peculiarity of all that he has ever written upon science, that some minds can draw inexhaustible nourishment from his essays and letters. Many will miss portions of the larger volume; but, in return for what has been omitted, the editors have given three important letters from Clerk Maxwell to Faraday, and one of Faraday's to him. The volume also contains letters to Dr. Huggins on the structure of comets. His letter to Faraday, upon the latter's idea of lines of force, shows clearly how strongly the new conception had taken possession of his mind. In this letter he says, —

> "You have also seen that the great mystery is, not how like bodies repel and unlike attract, but how like bodies attract by gravitation. But if you can get over that difficulty, either by making gravity the residual of the two electricities or by simply admitting it, then your lines of force can 'weave a web across the sky,' and lead the stars in their courses, without any necessarily immediate connection with the objects of their attraction."

It is highly interesting to read the letters which passed between these distinguished men. It was perfectly natural for Maxwell to express his physical ideas in mathematical language; while Faraday, unversed in mathematics, could nevertheless express his conclusions in a logical shape, which were the translations into ordinary language of the results of Maxwell's equations. In one place Faraday writes, —

> "There is one thing I would be glad to ask you. When a mathematician, engaged in investigating physical actions and results, has arrived at his conclusions, may they not be expressed in common language as fully, clearly, and definitely as in mathematical formulae? If so, would it not be a great boon to such as I, to express them so, translating them out of their hieroglyphics, that we also might work upon them by experiment?"

The life of James Clerk Maxwell; with selections from his correspondence and occasional writings. By LEWIS CAMPBELL, M.A., LL.D., and WILLIAM GARNETT, M.A. New edition, abridged and revised. London, *Macmillan*, 1884. 16+421 p. 8°.

In these days of renewed interest in the establishment of physical laboratories, it is interesting to read Maxwell's views of the best method of conducting these laboratories. In a letter to Mrs. Maxwell, he says in regard to the Cavendish laboratory at Cambridge, —

> "There are two parties about the professorship: one wants popular lectures, and the other cares more for experimental work. I think there should be a gradation, — popular lectures and rough experiments for the masses, real experiments for real students, and laborious experiments for first-rate men."

Rarely has the true solution of the problem of the proper course in the direction of a laboratory been more clearly stated.

Many who know nothing of the nature of the studies to which Maxwell devoted his life, will read his life, and find it a fascinating one. The philosopher will ponder over the views of the structure of the universe, and Maxwell's endeavor to do his duty in a world some of whose mysteries he set himself to discover. The physicist will find it easier to read the treatise on heat, and the treatise on electricity and magnetism, by becoming better acquainted with the habits of thought of Maxwell as they are revealed by his own letters in this little volume. The devout Christian will find in Maxwell an exemplar to whom he can point with unanswerable words as an illustration of the satisfying power of the Christian faith to a mind which has had few equals in the history of the world, and which, nevertheless, clung to the Christian religion as the only satisfying thing in the end.

THE PART PLAYED BY THE CELL IN LIVING ORGANISMS.

LIKE most other new doctrines, the cellular theory has been given too wide an interpretation. Within the last few years, botanical research has proved that the essential living part, the protoplasm, is often united by slender threads passing from cell to cell. A similar connection has also been demonstrated in certain animal organs. Nevertheless, 'cells' remain actual facts, and very important facts, of which the biologist has to take account. The cellular theory may be modified in detail, but it will remain true in essentials. With regard to certain cells, even in the highest animals, as the amoeba-like corpuscles which creep all over our own bodies in the lymph-channels, and play an important part in the regeneration of injured tissues, it is certainly true, even in its most extreme form. At this critical epoch in its history, a brief account of the development of the cell-doctrine may be of interest. We condense it from the pages of Canon Carnoy.

Robert Hooke (1665) first applied the word 'cell' in describing the structure of plants. He did not, however, regard cells as separate pieces of living matter, but compared them to cavities in a continuous mass, like the cells of a honeycomb. Malpighi (1675) recognized that vegetable cells were distinct, apposed, closed sacs. Leeuwenhoek, in his letters to the Royal society of London (1680–95), called especial attention to the cell-membrane or envelope. From this time, for about one hundred years, vegetable cells (animal being unknown) were regarded as little bladders filled with a homogeneous liquid.

The next advance was made in 1781, when Fontana described and figured within some cells an 'oviform body provided in the centre with a spot.' This earliest observation of the cell-nucleus remained practically unheeded for fifty years, and then R. Brown of Oxford confirmed and greatly extended it. He first demonstrated that the nucleus was a normal and usual constituent of vegetable cells. The 'spot' inside the nucleus seen by Fontana, and now known as the *nucleolus*, was rediscovered by Valentin in 1836. At this epoch, therefore, the *cell* was defined as "a vesicle with a solid envelope, containing liquid in which a nucleus with its nucleolus floated." Starch grains, chlorophyl bodies, and crystals had also been seen in various cells.

The next step forward was the recognition of cells as independent individuals, or 'elementary organisms.' Turpin and Mirbel promulgated this view about 1826; but it was Schleiden's 'Grundzüge der wissenschaftlichen botanik' (1842) that led to any general acceptance of it by scientific men. Since then, Schwann, Max Schultze, Brücke, and many others, have firmly established it.

Meanwhile, the relation of cells to the large plants in which they were found, was being studied. Malpighi and Leeuwenhoek both believed that such plants were essentially made up of juxtaposed cells. Schleiden and others, especially Hugo von Mohl (1827), finally demonstrated that vegetable tissues, as a whole, were but aggregates of more or less modified cells, which had a common origin, and were all at first alike, but often became greatly altered in the growth and development of the plant.

La biologie cellulaire: étude comparée de la cellule dans les deux regnes. Par le Chanoine J. B. CARNOY, professeur à l'université catholique de Louvain. Lierre, *Joseph Van In et cie.*

About 1830 the cell-doctrine was accepted, so far as concerned the vegetable kingdom. That it was also applicable to animals, was stated by Dutrochet in 1824; but it remained for Schwann to prove in his classical treatise (1839) the correctness of this thesis. From that time the cellular theory may be regarded as definitely established. Its extension to the explanation of certain pathological processes by Goodsir (1845) and Virchow (1859) was a noteworthy advance.

All this time the definition of the cell, accepted at the time of Valentin's work, was undergoing modification. The protoplasm was discovered, and its fundamental importance recognized. Bit by bit the essential structure of cells was simplified, until now the term denotes nothing but an independent particle of protoplasm. This particle may have, and often has, a nucleus in it, and a cell-wall around it; but both may be absent, and the tiny mass live and grow and multiply. Such modifications, in our conceptions as to what parts are necessary to the construction of a cell, do not, however, in any way essentially alter the cell-doctrine: it still remains a fundamental truth, the basis of all morphology and physiology.

Of late years a vast number of important papers have appeared, dealing with the structure and the properties of cells. They are scattered over the pages of many journals, and written in many languages; and the time had come for some one to collect and unify them. A good summary of the more important results of the work of the past twenty years, and a bibliography, aiding those desiring more detailed information to find it in original sources, was a necessity. Canon Carnoy undertook this task; and, so far as the present fascicule of his treatise on the 'Cellular biology' goes, has performed it well. The instalment published contains two hundred and seventy-one pages, of which, however, only the final hundred deal directly with cells. The introductory pages contain an exposition of the objects and methods of education, which we heartily commend to all teachers of natural history; also directions in histological technique, which, for students of general biology, are more useful than those in any text-book of microscopy with which we are acquainted.

The subjects discussed in the final hundred pages are as follows: discovery of the cell and of its parts; elementary organisms; the cellular biology; protoplasm; the properties of living matter; the general structure of the cell, and its newer definitions; the structure and general composition of protoplasm and nucleus; the general laws of the cell; the structure and composition of the nucleus in detail. The last topic occupies more than sixty pages, and is of great value as bringing together in convenient form the main results of the many researches on nuclei made during the last ten years.

An important and gratifying feature of the book is that its illustrations are not only good, but new. It is difficult to express fully our gratitude for this: those who have been wearied by seeing the same veteran woodcuts dragged out once more for duty in each new text-book, will, however, appreciate the gladness with which we greet these new, and in most cases better ones.

While we heartily commend Canon Carnoy's book for its scientific merits, we think that it has another claim to the attention of all who are interested in the progress of human thought: it marks the close of an epoch. Written by a professor in a Catholic university, in a Catholic country, and utilizing and accepting as it does the results attained by the best biological workers and thinkers independently of all theological prejudice, it is a sign, among many, that modern biology has won its battle. There will still be occasional echoes of the struggle, and we may for some time to come meet such instances of persecution as that to which Professor Woodrow was recently subjected; but the war is over. The religious world in general recognizes daily with greater clearness that science is not necessarily irreligious; and that the conviction that our universe has been developed and is governed in accordance with immutable laws, is compatible with belief in an all-wise Law-giver.

LANGLEY'S WORK ON MOUNT WHITNEY.

FROM a scientific point of view, the 'Report of the Mount Whitney expedition of 1881' is unquestionably one of the most important volumes which has ever been issued by our government. It presents fully and clearly, not only the observations made upon the mountain, with their results, but also much of the preliminary work and discussion which showed the need of such an expedition, together with a description of the ingenious and delicate apparatus devised by Professor Langley for the investigation.

Researches on the solar heat, and its absorption by the earth's atmosphere. A report on the Mount Whitney expedition. By Prof. S. P. LANGLEY. Washington, *Government,* 1884. (Prof. papers U. S. signal serv., xv.) 242 p., illustr., 21 pl., map. 4°.

To a certain extent, the principal results have already been given in various papers read before the National academy of sciences, and printed more or less fully in the different scientific journals; but we now have, for the first time, the details of the observations and computations from which the results have been derived, and are put in possession of the facts necessary to a due appreciation of their weight.

The first of the twenty-one chapters of which the report consists, is occupied with the preliminary observations at Allegheny during 1880 and 1881, — observations which brought out clearly the fallacy of most of the methods and conclusions previously adopted, and the necessity of a careful series of observations at some elevated station.

The second chapter contains an account of the organization of the expedition under the auspices of the signal-service, and gives the story of the journey, with a description of the stations. It is made quite clear that Mount Whitney is a station every way adapted to the purposes for which it was selected; and every one interested in science will most sincerely join in the author's hope "that something more than a mere ordinary meteorological station will be erected here, and that the almost unequalled advantages of this site will be developed by the government."

The third chapter contains a brief historical summary of the actinometric work done by various observers previous to 1880. We miss in it, however, any allusion to the labors of Secchi, Rosetti, and Waterston.

The next five chapters are devoted to the pyrheliometric and actinometric observations made by the expedition, with all necessary details as to the apparatus and methods of reduction. Professor Langley condemns the pyrheliometer of Pouillet as liable to give a very inaccurate determination of the quantity of heat actually brought by a given sunbeam under given circumstances; and he appears to consider the globe actinometer of Violle as, on the whole, the best when the constants of the instrument have been determined with sufficient care. The summary of results in chapter ix. makes it very clear, however, that the mere inaccuracies of observation are not so prejudicial to the satisfactory determination of the 'solar constant' as the use, in the reductions, of the fallacious assumption that the amount of radiant energy transmitted through an imperfectly transparent medium is given by the long-accepted formula, $C = Ea^{\epsilon}$, in which E is the 'solar constant,' a a constant 'coefficient of transmission,' and ϵ the 'thickness' of the air-stratum through which the rays penetrate. To bring out this fallacy is one of the author's main objects; and he sets it in a striking light by certain comparisons, given on pp. 69 and 119, between the results obtained at Lone Pine and at Mountain Camp, eight thousand feet higher. We note, however, that, by a sort of impish perversity of typographical luck, 1.797 is printed for 1.707 on the ninth line of p. 119, making the printed figures egregiously contradictory of the conclusions asserted in the text.

The fallacy consists in neglecting the fact that the solar radiation is not homogeneous, and in assuming, that, while such is the fact, the formula given above is applicable, provided one determines with care a sort of mean value for a by the comparison of observations made at different altitudes of the sun. In chapter x. the author discusses the matter fully, and shows mathematically that *values of the solar constant, obtained by reducing, according to this formula, any possible actual observations, will inevitably be too small, and probably very much too small.*

Chapters xi., xii., and xiii. are taken up with the description of the special apparatus devised by the author to meet the difficulty, and with an account of the observations made with the spectrobolometer at Mount Whitney and Allegheny; other chapters are devoted to the 'transmissibility' of our atmosphere for light, and to sky and nocturnal radiation; and others yet, include an interesting summary and discussion of the hygrometric and barometric observations. The report proper closes with a general summary of results. As regards the 'solar constant' itself, the author's conclusion is, that "at the earth's mean distance, in the absence of its absorbing atmosphere, the solar rays would raise one gram of water *three* degrees Centigrade per minute for each normally exposed centimetre of its surface." According to this, the 'solar constant' is three (small) calories (gram degrees) per minute per square centimetre, — equivalent, of course, to thirty large calories (kilogram degrees) per minute per square metre. The hitherto received values range from twenty to twenty-five. Other results of great importance are also indicated, relating to the wave-length of 'dark-heat,' the theory of the maintenance of the earth's temperature by its overlying atmosphere, the amount of absorption by this atmosphere, and a number of other related subjects. We have not room to quote them, and they would better be read in their connection.

There are also three appendices, — the first relating to the reduction of the psychrometer observations, which, at the summit of the mountain, show certain considerable discordances; the second, on the experimental determination of wave-lengths in the invisible prismatic spectrum, — a paper already published elsewhere, but most appropriately reprinted in this connection; and, finally, an investigation of the effect of convection-currents upon the loss or gain of temperature by a thermometer-bulb.

There can be no question that Professor Langley's exposure of the fallacy of the earlier methods of investigating the solar radiation, and his invention of the spectrobolometer, will always be recognized as an epoch in the history of the subject; and in the volume before us we have the best available summing-up of the matter.

It would be unjust to close this notice without an allusion to a fact which is well and gracefully stated in Gen. Hazen's brief preface: "It should be said that the aid given to Professor Langley [by the signal-service], which he so gracefully acknowledges in the text, was necessarily limited. A large part of the expense of the outfit was generously borne by a friend of the Allegheny observatory." To this anonymous friend, as well as to the signal-service and to Professor Langley himself, the thanks of all who are interested in science are due, and are hereby returned.

NOTES AND NEWS.

THE legislature of Wisconsin has appropriated a hundred and ninety thousand dollars to the University of Wisconsin, for rebuilding the science laboratories destroyed by fire on Dec. 1, 1884. The new buildings will consist of a chemical laboratory, a machine-shop, and a building for the departments of physics, engineering, geology, and zoölogy. All are to be fire-proof, or, more accurately, 'slow-burning,' buildings; and the heating-apparatus for all is to be placed in a separate structure. In addition to the above-named sum, the insurance on the former building, amounting to some forty thousand dollars, is appropriated for refitting the departments with necessary furniture and apparatus for immediate use. No appropriation for cabinets, etc., was urged, as the next legislature will meet before the completion of the new building. It is proposed to push the construction of the chemical laboratory and machine-shop as rapidly as possible. Since items have appeared, asserting that the Lapham herbarium was destroyed, it may be stated that the herbarium was not in Science hall, and is consequently intact.

— In their report on Edison's autographic telegraph, the examiners of telegraphic apparatus at the Philadelphia electrical exhibition write, "It was not set up in such manner that its construction or mode of operation could be examined, and we are therefore unable to report upon it. It may, perhaps, be proper to say that the autographic system for the transmission of communications in facsimile would seem to afford one of the most promising fields for the labors of future improvers of the telegraph. It is apparently in this direction, if any, that we must look for the future solution of the problem of cheap telegraphy. It will be readily understood that if an efficient system were invented by which the original message, as written by the sender, could be placed in a machine, and a facsimile of it instantly produced by the action of electricity at a distant station, and this by automatic machinery without the intervention of human hands, the actual cost of performing the service would be but the merest trifle. Yet there is apparently no obstacle in the way of obtaining this result, which we may not hope to see overcome sooner or later by the genius and perseverance of our inventors."

— The Leander McCormick observatory of the University of Virginia was inaugurated on April 13; the ceremonies taking place in the public hall of the institution, and Professor Asaph Hall of the naval observatory, Washington, delivering the address. The principal instrument is the great Clark refractor of twenty-six inches' aperture. The observatory has a house adjoining for the director, Professor Stone, and is possessed of a considerable endowment fund, the gift of Mr. W. H. Vanderbilt of New York.

— Capt. Thompson of the schooner R. Bowers reports that on June 4, 1884, in latitude 42° 46′ north, longitude 60° 47′ west, a sealed bottle, inside of which was placed a record of their voyage, was thrown overboard. The bottle, with record, was picked up on July 15, 1884, at Little Dover Bay, east point of Nova Scotia.

— A pamphlet has been issued by Dr. John S. Billings, the secretary-general of the International medical congress, to be held in Washington in 1887, giving the rules for the congress, and a provisional list of officers.

— The circular of the summer school of languages at Amherst for the coming session, exhibits an enlargement of the methods and aims of the school, and an increase in the number of subjects taught and of teachers demanded, which, a few years back, any one would have been thought over-sanguine to predict. The growth of the school seems to indicate plainly that it has created a demand for itself, and that its management is meeting the necessities of the case in a satisfactory manner. Professor Montague, of the department of modern languages in Amherst college, is the director of the school: and he has the immediate co-operation, in German, of Professor Zuellig, now an instructor at Princeton; in French, of Professor Bernard of Boston; in Latin, of Professor Johnson of Lehigh university; and in Hebrew, of the well-known specialist, Dr. Haley. Thirteen other instructors in language are also announced; and the generosity of the officers of the college in

making its cabinets, museums, and library collections available to the students of the summer school, is worthy of note.

— In commenting on the automatic chemical telegraph, the committee on telegraph apparatus at the Philadelphia exhibition says that this system was at one time in commercial use to a considerable extent in this country, but has been abandoned for reasons probably due more to peculiarities in the commercial requirements of American telegraphy than to any inherent difficulties in the operation of the mechanism itself. The automatic method of transmission, although full of promise, has in almost every instance failed to realize the expectations of its advocates as a substitute for the ordinary process of manual transmission. This difficulty, whatever it may be, is inherent in the principle itself, and is not properly chargeable to defects in the operation of the apparatus.

— The *Auk* for January contains the preliminary report of the committee on bird-migration, of the Ornithological union, from which it appears that observing-stations are now established in every state and territory in the Union, except Nevada. Returns have been received from over one thousand observers, who are usually, not ornithologists, but, as a rule, intelligent farmers, who know only the very commonest birds. The most eastern station is at St. John, Newfoundland; the most northern, at Belle Isle, off Labrador; and the most southern, at Sombrero Key, Fla. Reports have also come from many points on the Pacific, and even from as far north as Point Barrow, Alaska. The amount of information so far received is so comparatively meagre, that it is impossible to generalize as yet; but the various observers are working with great interest in the matter, so that it cannot be long before many valuable generalizations can be drawn from the data which are so rapidly coming in.

— The third lecture before the San Diego society of natural history was on the Sudan, delivered by Stuart Stanly; and the visit of Dr. Farlow was improved by engaging him to give the fourth.

— According to the Journal of the Iron and steel institute, large deposits of iron ore have been discovered in Cuba, the extent of which will cause the island to take rank with other countries as a source of supply of the raw material for iron-making. An American mining engineer states that he is familiar with most of the rich fields in the United States and in Europe, but that he has never seen any like those of Cuba. He adds that he has seen veins of iron ore, but that there are on the surface immense deposits, varying in thickness from ten to fifty yards, mostly in blocks of from two to twenty tons' weight. At one place he found by actual measurement that there must be present about 1,837,450,000 cubic yards of ore. This deposit is situated only about half a mile from the sea, where a good harbor can be opened to ship the ore. Farther in the interior there is another large deposit.

— The Royal society of New South Wales offers its medal and twenty-five pounds for the best communication (provided it be of sufficient merit) containing the result of original research or observation upon each of the following subjects: — to be sent in not later than May 1, 1886, on the chemistry of the Australian gums and resins; on the tin deposits of New South Wales; on the iron-ore deposits of New South Wales; list of the marine fauna of Port Jackson, with descriptive notes as to habits, distribution, etc.: to be sent in not later than May 1, 1887, on the silver-ore deposits of New South Wales; origin and mode of occurrence of gold-bearing veins and of the associated minerals; influence of the Australian climate in producing modifications of diseases; on the Infusoria peculiar to Australia.

— The meteorological summary for February, 1885, at San Diego, Cal., gives the mean daily temperature at 55.9°; the highest temperature, 76°; the lowest temperature, 37.6°. The mean daily relative humidity was 77.7, with only .01 of an inch of precipitation, against 9.05 inches of precipitation in February, 1884.

— Rev. E. L. Greene, of the University of California at Berkeley, intends making a botanical trip in April to the Guadaloupe and the Cerros Islands, off Lower California.

— The applications for space in the Inventions exhibition at South Kensington have been enormous. If all the applications had been granted, it would have required an area six times as large as Hyde Park to contain the exhibits; yet the inventions are confined to the last twenty-three years, and the music, with the exception of the historical collection, restricted to this century. Steam engines and boilers have the largest share of space; electricity, naval architecture, and mining and metallurgy, having the next.

— The total distance run by the cars on the Brighton (England) electric railway during the first six months of its existence was fifteen thousand six hundred miles. Two hundred thousand passengers were carried, at an expense of five cents per mile.

— It is reported that the experiment is to be tried in Berlin of running the street-cars by electricity. Storage-batteries of the form supplied by the Electric-power company of London will be employed.

— The Messrs. Orcutt of San Diego, Cal., intend penetrating the Lower Californian peninsula as far as possible by wagon this spring, with the object of investigating its flora.

— Mr. D. S. Smart, in a paper recently presented to the British institution of civil engineers, describes recent British practice in steam-boiler construction. He states that 'low,' 'soft,' or 'mild' steel, which has the valuable qualities of iron without its defects, is now extensively used for this work. It is made usually from thirty to thirty-six per cent stronger than boiler-iron, and is superior, when well made, in ductility. Some variation in this last respect has led to considerable distrust of the metal; but this distrust has been quite often due to unfamiliarity, on the part of users, with the nature of the material, and

with the proper methods of manipulating it. Some brands are found to weld like iron, while others will not weld, and are brittle. No accident of serious character has yet occurred, however, to any steel boiler, so far as reported. It is not yet fully ascertained to what extent deterioration may affect the safety of steel boilers. It is anticipated, however, that the metal is likely to prove more satisfactory in this respect than iron. Steel rivets are used to some extent, and their use is continually increasing. More care is requisite in their working than is demanded in the use of iron rivets. It is desirable that all parts of the boiler, and, as far as possible, of its appurtenances, should be made of steel, in order that voltaic action and consequent corrosion may be avoided. Steel plates are usually drilled, instead of being punched, as it is found that steel is more liable to injury by punching than iron.

— The seventh volume of the *Bulletin* of the National academy of sciences, of Cordoba, is entirely occupied with a monograph on Staphylinidae, or rove-beetles, of Buenos Ayres, by Arribálzaga, which is completed with the third number, just received, making altogether nearly four hundred pages.

— The Portuguese explorer, Serpa Pinto, has undertaken a fresh expedition into central Africa. He intends to start from Mozambique in the direction of Lake Tanganyika, crossing the Muropue country, where he hopes to meet with the Portuguese Kongo expedition.

— A French commission has left Marseilles to further the Roubaire scheme of an inland sea in the African desert. The destination of the commission is Gabes, where a harbor is to be made as an outlet for the connecting canal.

— Town councillor Helm of Dantzig has given his collection of three thousand specimens of amber insects, and seven thousand beetles, to the West-Prussian provincial museum, on condition that they are left in his own house during his lifetime.

— The British steamship Chicago, Capt. Jones, reports that on March 25, in 41° 14′ north, 62° 10′ west, at two P.M., a very heavy vapor was observed on the surface of the sea; and distributed about in this vapor were hundreds of miniature water-spouts, rising about twenty feet high. Immediately over this part of the water was a large, black, arched cloud. The barometer at the time was 30.09, air 48°, water 61°; winds moderate from the southward.

— In the April number of the *American journal of mathematics*, the contributors, seven in all, hail, two from Baltimore, and one each from Paris, the Royal academy at Woolwich, Toronto, Bremen, and Porto.

— Among recent deaths we note the following: Major F. J. Sidney Parry, one of the oldest members of the Entomological society of London, in The Warren, Bushey Heath, Feb. 1; J. A. Serret, mathematician, at Paris, March 3; Nicolas Sewertzow, zoölogist, Feb. 9; Gen. G. von Helmersen, geologist, member of the Royal academy of sciences since 1844, at St. Petersburg, in his eighty-third year; Geoffrey Nevill, formerly assistant superintendent of the Indian museum at Calcutta, at Davos, Feb. 10; Dr. Ernst Erhard Schmid, professor of mineralogy in the university of Jena, at Jena, Feb. 16, in his seventy-first year; Carl Theodore Ernst von Siebold, professor of zoölogy in the university of Munich, at the age of eighty.

— At a meeting of the Society of chemical industry, held in Glasgow on March 3, Mr. James Murrie read a paper on the processes employed in Italy for the extraction of oils, etc., from bituminous rocks in that country. At the outset he said that the Italian government had given great facilities for developing the internal resources of the country, particularly with regard to carbonaceous deposits. There was a general belief that a belt of oil passed through the Apennines in the direction of Roumania, and curved out near Bucharest. There was, however, really no such thing as an oil-belt in Italy. The deposit of oil and bituminous rocks, which had received the greatest attention, was situated in a spur of the Apennines known as the Abruzzo, in the province of Chieti, twenty miles inland from the town of Pescara, on the Adriatic. The indications of bitumen occurred in the form of asphaltic rock, found in a superficial deposit on the slope of the mountain. Going on to speak of the extraction and manufacture of oil from the rock, Mr. Murrie remarked that about twenty companies had started operations for the purpose of utilizing this mineral. These ventures had invariably turned out failures; the cost of refining it being too high, and the density of the oil produced too great, to allow of its being used for burning-purposes. So far as his observation went, the only uses it could be put to were in street-lighting, for mining-purposes, and in the preparation of lubricating-oils.

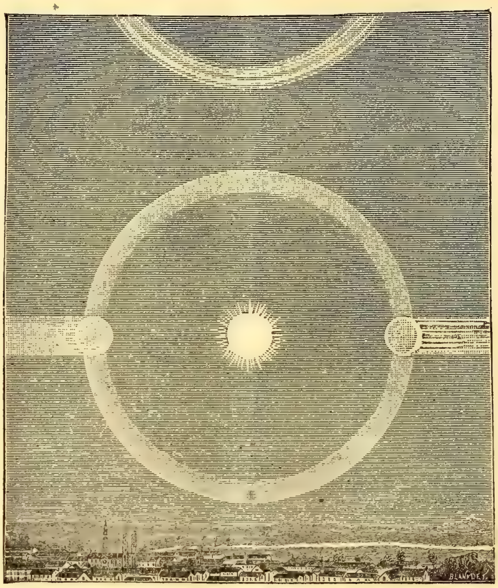
— In addition to the numerous uses to which the wonderful network of Parisian sewers has already been put, we learn from *La lumière électrique* that the lines of telephone-wires are now being placed upon these underground walls. This is simply following the example of the telegraph companies, who did the same in 1880. The sewers also contain two large water-pipes, — one for household, the other for sprinkling purposes; and, besides, a pneumatic tube used for the transmission of messages, and a smaller pipe which transmits the air-pressure for the system of pneumatic clocks distributed throughout Paris.

— Mr. E. E. H. Francis recently read a paper at the London chemical society in which he showed that filter-paper, ordinarily so weak, can be rendered tough, and at the same time pervious to liquids, by immersing it in nitric acid of relative density 1.42, then washing it in water. The product is different from parchment paper made with sulphuric acid, and it can be washed and rubbed like a piece of linen. It contracts in size under the treatment, and undergoes a slight decrease of weight; the nitrogen being removed, and the ash diminished.

— The king of the Belgians has planned an International geographical society, and has summoned Milne-Edwards of Paris to be his helper therein.

— According to the committee on telegraph apparatus at the Philadelphia electrical exhibition, the possibility of employing a single conductor for the simultaneous transmission of two or more sets of telegraphic signals appears to have originated with Moses G. Farmer of Boston, Mass., about the year 1852. Mr. Farmer attached to each end of the line a rapidly revolving commutator or distributer. The two distributers, when caused to revolve synchronously and in unison, served to bring the line successively and simultaneously into connection with a corresponding series of short branches at each terminus, in each of which branches ordinary telegraphic apparatus was inserted and operated in the usual manner. Thus the current through each pair of corresponding branches at either station, while apparently continuous, actually consisted of intermittent but rapidly recurring synchronous pulsations. Mr. Farmer successfully experimented, upon a small scale, upon the wires of the municipal telegraphic lines of Boston in 1852. Nothing of permanent value, however, resulted from the experiments at that date, the difficulty of maintaining the absolute synchronism required for operating for any considerable length of time being apparently insuperable.

— *L'Astronomie* reports a most remarkable halo seen by M. D. Luzet on the 17th of January last at Orleans, France. There were no clouds in the sky, simply a light mist, and the temperature was — 1° C. At 12.40 P.M. a very brilliant circle, with a radius of 22°, appeared around the sun; and, at the two extremities of the horizontal diameter of this circle, two white spots were formed, which, gradually increasing in intensity, became very brilliant at 12.55. Above, and not touching the circle, was a rainbow, which gradually faded out at its extremities into the blue sky. The red of this bow was outside, the violet within, and the brightness and distinctness of the tints were very marked.



HALO SEEN AT ORLEANS, FRANCE.

— The recent fire in the capitol at Trenton, N.J., inflicted considerable loss on the geological collections of the state. The suites of typical rocks from the several formations, and large collections of iron ores, clays, marls, and soils, were all lost; and some old state maps, now out of print, were destroyed. The old collection of H. D. Rogers was lost; that of Dr. Kitchell was saved. Fortunately, a large number of selected representative specimens of rocks, ores, woods, etc., escaped by being in the state exhibit now at New Orleans; and while the loss, as a whole, is a serious one, it is not irreparable. In the continued prosecution of the state survey, it will be possible in time to make a fuller and more representative collection than that which is destroyed. It is to be hoped that the new rooms, which we understand are to be provided for the museum, will be of safer construction, and, if necessary, isolated to make them more secure.

— The *Echo du Japan* reports the arrival in Japan, at the beginning of the year, of Joseph Martin, a French traveller, who had just been exploring the parts of Siberia hitherto very little known. His principal journey was from the Lena to the Amoor, across the Stanowai chain of mountains. During his explorations he was able to make geographical and geological collections, which are intended for the Paris museums. In consequence of hardships endured on the journey, two of his native followers died, and one lost his reason.

— Mr. Ellery of the Melbourne observatory has taken the necessary steps toward the organization of a small expedition to the southern coast of the north island of New Zealand, in the coming September, to observe the total eclipse of the sun, which occurs on the 8th of that month. The track of the line of total eclipse lies almost wholly in the South Pacific Ocean, and New Zealand is the only land crossed by it; the duration of totality lasting about two minutes at the spot most favorably located for the observation.

— The legislature of New York has passed an appropriation of twenty-five thousand dollars for the State survey.

— A bill has passed the Wisconsin legislature providing for the education of deaf-mutes. Hitherto there has been no special provision for their instruction.

— The topographical map of New Jersey, to which attention has been called already several times, has now advanced to the point of issuing six sheets in all. They are fine pieces of work, of which the state may justly be proud. Eleven more sheets remain to be done.

— We neglected to state in our last that the facsimile of the map by General Gordon, of the route from Suakin to Berber, was published by Edward Stanford, 55 Charing Cross, London.

SCIENCE.

SUPPLEMENT TO No. 115, FRIDAY, APRIL 17, 1885.

REFORMATION OF SCIENTIFIC LEGISLATION.

Among the propositions floating in men's minds with regard to the re-organization of the scientific and economical works of the federal government are several that can easily be disposed of as impracticable or otherwise objectionable. It will be necessary to enumerate and dispose of a few of these before suggesting any satisfactory solution of this important question.

1. The proposition to put the conduct of the specially scientific work, such as geology, geodesy, meteorology, astronomy, into the hands of the Smithsonian institution. This institution is supported wholly by the income of trust-funds dedicated to a specific purpose by James Smithson, for whom the government accepted the position of executor; and the government cannot legally impose upon this institution any labors or expenses not warranted by the terms of Smithson's will, as interpreted by the highest legal authority in the land. The proper interpretation of the intent of the testator has already been so clearly settled and widely accepted, that it is incredible that now, in the full tide of the prosecution of his desires, the government, as executor, will attempt to divert his funds to other uses. But it will be said, the United States has merely to appropriate additional funds to enable the institution to carry out the proposed increase in its work and responsibility. This seems plausible; and if carried into effect, although it would seem to add these duties to those of the present secretary of the institution, yet it need not necessarily do so: in fact, it is not to be supposed that the United-States government would put the conduct of all its public works into the hands of one man. Probably the authors of this plan had in mind the regents of the Smithsonian institution, and not the secretary, as the body to which the government should assign its scientific work: in other words, to the regents of the Smithsonian should be confided the question of the conduct both of that institution and of all our public works. It is argued in favor of this, that we have here one institution of a high character, managed by men already organized and recognized, and that the transfer of others to them would be a simple matter. It already has charge of not only the Smithsonian institution proper, but of the national museum, fish-commission, bureau of ethnology, the care of the collections made by geological surveys — and why not of every thing else? But there are many other organizations under government auspices, composed of men who stand ready to undertake great trusts; and who will maintain that the regents have any special qualifications over others? By the law of 1846, the board of regents consists of eight persons chosen from the legislative and executive bodies, and six other persons not members of congress (two of them resident in Washington, and the other four from distant states). Among the twelve persons now constituting the board of regents, we find only one person that can be called a scientific man, — Professor Asa Gray of Cambridge. From the beginning, the policy of the regents has been to appoint a scientific and practical man as secretary, or superintendent, or director of the institution, who is, in fact, simply an autocrat, although legally he is the executive officer of the board of regents. Under this arrangement, various branches of activity have prospered, such as the library, the museum, the departments of exchanges, of publications, of meteorology, mineralogy, anthropology, etc.; and these departments have grown to be large divisions of work. The work of the fish-commission seems never to have been carried on at the expense of the Smithsonian, but was entirely extra work fostered by the regents, in that Professor Baird was allowed to give a portion of his time to it, while the expenses were borne by special appropriations from congress: we may therefore look upon the U. S. fish-commission, which was established by law in 1871, as a scientific and practical institution, fostered by the Smithsonian, but having an independent existence of its own. The policy of the

institution has been little by little to secure an independent existence for each of its varied departments, so that the trust-funds at its disposal could be utilized for new fields of work, — a policy fully justified by the intensely practical value of its labors in the increase and diffusion of knowledge. Thus it happened, that, as soon as the library of congress had an organization and income sufficient to warrant the step, the Smithsonian transferred to its care its large scientific library, and relinquished the idea of maintaining a separate library of its own. Similarly, in 1874, the signal-office weather-bureau having apparently a separate existence of its own, the institution transferred to it its great collection of meteorological data and correspondence, thus relinquishing its own division of work in that department. More recently its system of international exchanges, as also its museum and its mineralogical and anthropological collections, have been recognized as worthy of special encouragement by the government, and have been either made into separate departments, or partially transferred to the geological survey, the national museum, etc.

In a hundred ways the devoted chiefs Henry and Baird have known how to stimulate and co-operate in the increase and diffusion of knowledge. It is now proposed to reverse this process by which separate institutions have grown up as children under the Smithsonian, and have gone out from it when able to stand alone, and to send them all back, with others, to the fostering care of the parent. Evidently, however, some new plan of organization must be adopted before these full-grown institutions can be comfortably housed together. The secretaries, Professors Henry and Baird, have neither of them ever indicated their ability, willingness, or desire to be burdened with the responsibility of so many great organizations; and the regents, composed of statesmen and the executive officers of the government, are not the proper persons to whom to commit these important interests, involving the annual expenditure of from five to twenty million dollars, and in respect to which the expenses of the present administration of the Smithsonian, or the responsibility of its present regents, are quite insignificant. Some satisfactory co-ordination of government work is certainly desirable, — such a co-operation of all departments as has been especially shown by the surgeon-general's office, the signal-office, the navy and the interior departments, in their relations with the Smithsonian. But to put all under the present board of regents of the Smithsonian, who are merely the advisers of our government as executor of Smithson's will, is not a very dignified proceeding, and is utterly contrary to the provisions and spirit of the federal constitution, according to which the executive power is vested in the president, to whom is allowed a cabinet officer in charge of each of the executive departments; and all disbursements of public moneys must take place through and with the authority of some one of these executive officers.

2. A second proposition has been thrown out by the committee appointed by the president of the National academy of sciences, Prof. O. C. Marsh. This committee, although consisting of members of the academy, does not speak with the authority of that academy as such, as its views were never submitted to, or ratified by, the academy. On the one previous occasion, when congress asked advice of the academy in a matter of legislation concerning the consolidation of surveys, the report of the committee was discussed, amended, and adopted by the academy as a whole, as, indeed, the importance of the subject warranted; and the recommendation of the academy was sufficiently mature to command the respect of all. In the present case this has not been done; and whatever aid or suggestion this present committee has given, is therefore to be credited to them individually, and has not the weight of the authority of the academy as such. The committee, after being shorn of two of its best members, has submitted two distinct propositions, both of which are, they say, 'the general sentiment and wish of men of science,' although they give us no hint as to how they discovered or drew out such expressions of opinion. Both their propositions embody the general feature of the collection of the scientific and other bureaus under one general authority, to be recognized as responsible for and controlling generally the scientific operations of the government. Among the definite forms that might be given to such central authority, they specify two; namely, —

(*A*) The establishment of a new special department of science as one of the principal branches of the executive department of the government (see article ii. of the federal constitution), to which shall be given the direction and control of all the purely scientific work of the government; and which work should be cultivated, they say, because scientific investigation promotes that general welfare the attainment of which was the object of the constitution.

(*B*) The transfer of all such work or bureaus as now exist to some one of the present executive

departments, in which department four bureaus should be organized to carry on the four principal classes of work: namely, 1. Geodesy, topography, and hydrography; 2. Geology; 3. Meteorology; 4. Physical standards of weights and measures. In order to assist the secretary in charge of the department to which these works are to be transferred, and under whom the four bureaus are to labor, the committee proposes the formation of a permanent commission, which is not charged with any administrative responsibility, but which shall be attached to the office of the secretary of the selected department, and, under his presidency, shall exercise a general control over the work of the four bureaus, and shall have charge and custody of all the archives, apparatus, and other things appertaining to their work. The commissioners are to receive a salary; and, if any of the four bureau officers spend money contrary to their recommendation, the commission shall notify the proper authorities. In general, the commission is to annually examine, improve, and approve the plans of work and estimates of the four bureaus, but is not charged with purely administrative responsibility: it recommends to the secretary or chief of the department whatever is necessary to the best work of the four bureaus, but has no power to enforce its own recommendations except by remonstrance to the auditor against payment of funds. The commission shall, it is suggested, consist of the secretary, the heads of the four bureaus, six officers of the navy and army, two civilian scientific men, and the representatives of the Smithsonian institution and the national academy, — fifteen in all; viz., one statesman, six military officers, four bureau officials, two scientific men, and two academicians. Presumably it is contemplated that all shall be chosen by the president or the secretary.

This second proposition of the committee of academicians we have given somewhat at length; and, if we have not misunderstood it, there is in the proposed advisory commission a want of strength, and absence of personal responsibility, a liability that science will be in the small minority, — a cumbersome number of persons, such that certainly all of them, or even a majority, will never enter into the merits of the numerous difficult scientific questions that will be laid before them. The consequence will be, that the whole commission will simply approve the recommendations of its own sub-committees, and thus, after all, the conduct of the four bureaus will be entirely in the hands of these bureaus themselves. We can easily grant that the transfer to one department, and the organization of four bureaus under its secretary, may be a great step towards economy, harmony, and efficiency: but the appointment of an irresponsible commission as advisory to the secretary, who is under more or less obligation to carry out its suggestions, on the one hand gives the fifth wheel to the coach, and on the other hand relieves both the secretary and the superintendents of the four bureaus of all personal responsibility; so that if any thing goes wrong, and congress should appoint a committee of investigation, the report must necessarily be that no one is to blame. This arrangement is inferior to that by which the people hold congress, and congress holds the secretary, while he holds the four bureau officers, to a strict personal responsibility; while each has perfect liberty to call in such advice as he feels in need of.

We have here three propositions. The important general feature of them all is that of consolidation, unification, and systematization of a certain class of government works, either under the Smithsonian, or under a new executive department, or under some existing department. Abstractly such consolidation appears desirable, it certainly pleases the mind of a systematic person; but whether it will result in the greatest good, for the greatest number, is a question that needs consideration, not so much from an idealistic stand-point as from the side of statistics, experience, and history. Can it be shown, from the experience of nations or smaller corporations, that the combination under one department of such diverse matters is really a step in advance? First of all, what are the diverse interests whose welfare we propose to secure? Only a partial exhibit of government work has been given in the act under which the commission is now proceeding, or in the statements that have been made before it, which specify only the signal-service, geological survey, coast and geodetic survey, and the hydrographic office of the navy. The very first act of the commissioners, in their letter to the president of the national academy, is to call attention to the fact that the preparation of their report involves nothing less than an investigation of four important branches of our government, all scientific in their character, and invites attention to the question, "In what way can these four scientific branches be best co-ordinated?" If such co-ordination on this smaller scale ever be accomplished with good results, it will be an argument for the application of the same principles to the remaining scientific, economical, and practical work of the government. It will therefore be well for us here to consider all such work as is now being prose-

cuted under the supervision of committees of federal officers, and of which the following is an approximate list of names that suggest the great variety of intellectual work going on under the government: —

LEGISLATIVE BRANCH.

SENATE.

1. B. — Standing committee on agriculture and forestry.
2. A. — Standing committee on mines and mining.
3. B. — Standing committee on fish and fisheries (fish-commission).
4. D. — Joint committee on the library of congress.
5. B. — Joint committee on public buildings and grounds (botanical gardens).
6. B. — Select committee to investigate the introduction and spread of epidemic diseases.

HOUSE.

7. E. — Standing committee of coinage, weights and measures.
8. A. — Standing committee of rivers and harbors.
9. B. — Standing committee of agriculture.
10. B. — Standing committee of railways and canals.
11. A. — Standing committee of mines and mining.
12. A. — Standing committee of public buildings and grounds.
13. A. — Standing committee of levees and improvements of the Mississippi River.
14. D. — Joint committee on the library of congress.
15. A. — Select committee on ventilation and acoustics.

EXECUTIVE BRANCH.

16. A. — Executive mansion. Commissioner of public buildings, including green-houses and propagating gardens.

STATE DEPARTMENT.

17. A. — Bureau of statistics.
18. D. — Bureau of rolls and library.

TREASURY DEPARTMENT.

19. Government actuary.
20. A. — Supervising architect's office.
21. C. — Bureau of engraving and printing.
22. B. — Bureau of statistics.
23. A. — Inspector-general of steamboats.
24. A. — Life-saving service.
25. B. — Commission on cattle-diseases.
26. B. — Commissioner of internal revenue.
27. C. — Director of the mint.
28. A. — Lighthouse board.
29. A. — Bureau of weights and measures.
30. A. — U. S. coast-survey.
31. A. — U. S. geodetic survey.
32. B. — Marine-hospital service.

WAR DEPARTMENT.

33. U. S. military academy at West Point.

Medical department.

34. Meteorological division.
35. B. — Medical museum, and medical history of the war.
36. Laboratory.
37. Library and bibliography.

Bureau of engineers.

38. A. — Mississippi-River commission.
39. A. — River and harbor improvements.
40. A. — Survey of Great Lakes.
41. A. — Survey of U. S. territory.
42. A. — Willett's Point school of engineering.

Public buildings and grounds.

43. Propagating gardens, aqueducts, Washington monument, etc.

Ordnance bureau.

44. Arsenals, armories, and ordnance depots.
45. Experiments on material, powder, etc.
46. Artillery school at Fortress Monroe.

Signal-service bureau.

47. A. — School at Fort Myer for meteorology and signalling.
48. A. — Weather-bureau.

NAVY DEPARTMENT.

49. U. S. naval academy at Annapolis.

Bureau of ordnance.

50. Manufacture of cannon, guns, arsenals, magazines.
51. Newport topedo station and service.

Bureau of navigation.

52. A. — Hydrographic office (charts, surveying, meteorology).

53. A. — Nautical almanac office.
54. A. — Naval observatory and chronometers.
55. A. — Compass and magnetic observatory.
56. *Bureau of steam engineering.*
57. *Bureau of construction and repairs.*
58. B. — *Bureau of medicine and surgery.*
59. B. — Museum of hygiene.

POST-OFFICE DEPARTMENT.

60. A. — Topographical division.

INTERIOR DEPARTMENT.

61. A. — General land-office.
62. C. — Patent-office (deals with all the sciences and their applications).
63. D. — Bureau of education.
64. Commissioner of railroads.
65. Geological and geographical survey.
66. D. — Census office.
67. Entomological commission.
68. National museum.

Agriculture bureau.

69. B. — Department of statistician and meteorologist.
70. B. — Department of entomologist.
71. B. — Department of botanist.
72. B. — Department of chemist.
73. B. — Department of microscopist.
74. B. — Department of forester.
75. B. — Department of experimental gardener.
76. B. — *National board of health.*
77. C. — *Civil-service commission.*

Commissioners for the government of the District of Columbia.

78. B. — Health office.
79. A. — Engineer's office.
80. A. — Surveyor's office.
81. D. — Superintendent of public schools.
82. *Smithsonian institution.*
83. B. — U. S. fish-commission (report to senate directly).
84. B. — Bureau of ethnology.
85. D. — National museum.
86. D. — Collections of U. S. geological surveys.
87. A. — Polaris report.

This list is sufficiently impressive. It is evident, that, in the growth of our nation and government, it has been necessary to undertake many works of general utility to the country, and to attack many questions in the sciences and the arts on which information is needed, either for the benefit of the legislative and the executive departments directly, or else with a view of distributing accurate information of immediate value broadcast throughout the land, for the benefit of the people at large.

Every thing relating to state relations, — diplomacy, war, law, finance, — it was easily seen in the beginning, must be conducted by the federal government. But matters of public domain — health, internal commerce, post-office, education, agriculture, patents, etc. — also demanded attention; and the departments of the interior, the land-office, and the bureau of agriculture, were provided. These special matters have so increased and subdivided, and have been so promiscuously assigned to various government bureaus, that often it is difficult to see any necessary connection between the nature of the work and the general character of the department under which it is now being conducted. If we were to re-arrange these eighty-seven items according to some approximate estimate of the intrinsic correlation of work, we should probably put the items marked A into one group: these all relate to surveys of land, with attending geodesy, standards of measurement, astronomical, physical, meteorological, oceanic, and geological work, and to such internal improvements as utilize the preceding.

In a second group, B, we should place all that relate to life and growth, health and disease, in the animal and vegetable kingdoms.

We should make a third group, C, of all that relates to manufacture of currency.

In the fourth group, D, we put all relating to the statistics and dissemination of useful knowledge.

This classification is theoretical or philosophical. If, on the other hand, we attempt something merely practical, we will perhaps re-arrange our subjects by simply selecting for the chief of each group that office which has at present the most successful organization, or which, being the largest, could most easily bear the addition of other branches. This would redistribute government work into the following bureaus: —

1. Bureau of surveys (including geodesy, astronomy, economic and military topography, geology, mineralogy, ethnology).
2. Bureau of hydrography and coast defence (including lighthouse and life-saving service).
3. Bureau of standards and adulterations (including physical and chemical laboratories for testing).
4. Bureau of hygiene.
5 Bureau of statistics.
6. Bureau of agriculture.

7. Bureau of mint and money.
8. Bureau of education (including pedagogy, library, museum).
9. Bureau of public works and improvements.
10. Bureau of patent-office.
11. Bureau of climate and weather.

We shall thus have eleven bureaus instead of the present numerous offices, and shall have succeeded in bringing together, in closer relation, a number of branches of public work. We may thus by so much succeed in simplifying the working machinery of the government, and possibly secure a slight economy and improved results; but we are still far from attaining that single scientific bureau, and thereby that recognition of science, which we are told is the general desire in this country, as also in others, and have by no means assured the general harmonious co-operation of these eleven bureaus in so far as that may be necessary. There is, in fact, no one of these bureaus whose operation is not more or less intimately associated with those of some others; and the ideal consolidation, when pushed to the extreme, would require the union of all these in one general department of science, education, and public works, — a slight combination, such as in these eleven offices still leaves unsatisfied the need of a higher general supervision.

Thus far we have only been considering the policy of the executive branch of the government as a business organization for the most economical administration of the laws originating in the legislative branch. If, however, we should consider what policy the legislative branch should adopt for the best welfare of the country, we should undoubtedly decide that it should give the greatest possible stimulus, first, to both the ordinary and the highest education of the people; second, to the execution of national works of public utility (especially taking into its own hands the conduct of any work of general importance, whenever that is neglected by private enterprise, or whenever it is monopolized by a few to the disadvantage of the mass of the people or of the government itself); third, to science and research as the means of developing the resources of nature and of the nation. Acting on these principles, other nations have, on the one hand, made a limited education compulsory, and, on the other, have provided the means for such education; they have demanded the highest attainments and the best work in each department of knowledge, and have provided universities and scientific schools where men can receive the necessary training; they have furnished most accurate topographic charts in order to facilitate the construction of roads, canals, and other internal improvements; they have displayed the greatest activity in labors relating to the public health, the development of agriculture, manufactures, and commerce, the prediction of storms and weather, protection against spurious coin and measures, adulteration, etc. In fact, most such other nations have exercised a more minute oversight over affairs, individually as well as collectively, than has been considered consistent with the liberty of the citizens in a republican government. It is perhaps not practicable for this nation, as yet, to go so far towards centralization as others have done; and yet we must look to our national legislature for some protection against the evils that arise from disconnected, and often discordant, individual actions. It must stimulate every one's work, and yet secure harmonious action on the part of those who are emulating each other both in public and private life. For instance: we have had, at one time, three or four topographical surveys, six or eight chemical laboratories, four or five meteorological bureaus, all in the government service, often working on the same or allied problems; while in civil life several other institutions can be found going over the same or similar ground. In this emulation and duplication lies the assurance that each will do his work to the best of his ability. The country, and the cause of knowledge, both profit by an occasional duplication of work: the whole progress of science consists in repeating the work of others in the light of newer discoveries or better knowledge, only it is necessary to know when such duplication is needed.

As the first and vital step towards a permanent improvement in the whole round of governmental work, we would not advise the diminution of government officials engaged in the above eighty-seven offices; we would not curtail the scope of the work carried on in each of those offices; we would not re-arrange them under some new classification, since even the best that can be thought of now is stiff, formal, and artificial, cannot foresee the progress of science, and will have to be changed a few years hence: we approve, rather, of the great diversity of work increasing every year, and carried on by the government for the benefit of the nation; the more work and workers, the greater stimulus given to the intellectual and material progress. Let each bureau do its work according to its own needs, whether these be military, ethnological, economic, statistic, topographic, or what not; but let there be somewhere an intelligent supervision of the whole field.

The natural intelligent head of the U. S. government is the legislative branch; and no great gain can result from a re-organization of the executive branch, without a corresponding enlightenment and improvement in the legislative. If any fault exists, or has existed, in the past and present administration of national scientific work, the trouble is not so much with the executive as with the legislative. The laws enacted by the latter, whether they result from suggestions from the country at large, or from the heads of departments, or their subordinates in Washington, are too often imperfect. Some public necessity starts the movement for the formation of a coast-survey, a weather-bureau, a geological survey; but all subsequent legislation is the result of a great deal of management on the part of the few men directly interested, who rarely give the subject the unprejudiced study that is needed in organizing such important concerns. One may know all about forestry or chemistry or statistical methods, may realize their practical importance, and may desire to inaugurate a bureau that shall push either of these subjects to the highest degree of perfection and usefulness; but when it comes to the questions where the bureau shall be placed (whether under military, naval, or civil laws), how the finances shall be administered, with what department it will best affiliate, and how wide its scope of duty shall be, the inaugurators of the new work are necessarily affected strongly by their limited knowledge or personal bias, that needs to be offset by a consultation with others of wider experience. The well-defined systematic statutes organizing the corps and work of the coast-survey (not the geodetic or the topographic survey); the engineer bureau; the Smithsonian institution; the fish-commission and other commissions; the land-office, post-office, patent-office, and other offices, — contrast strongly with the temporary fragmentary legislation referring to the work of the bureau of navigation, with its observatory, almanac, and hydrography, the census-office, geological surveys, signal-office, agricultural bureau, the library of congress, and other important national organizations. In general, it is well known that legislation touching scientific matters comes before congress from committees who have consulted with competent authorities to only a very slight extent; and especially do the more important actions taken by joint committees of conference almost invariably represent, not the wisdom of the wisest, but the will of the strongest, man on the committee. Any thorough solution of our trouble, any radical reform of existing evils, must provide for the infusion of greater scientific intelligence among our law-makers, and the presence among them of some authoritative board of appeal; so that, before turning over to the president and his cabinet a new item of public work, congress may have fully realized the probable bearings of other works upon it.

In 1863 the act organizing the National academy of sciences was enacted. This created a body of men eminently proper to act as advisers to the government upon any matter of science or its applications; and, as this advice is required by law to be given free of all charge, there have been numerous occasions on which such has been called for and given. Up to the end of 1883, forty-four such reports are enumerated; but we find only two such to have been called for by congress, and none by the judiciary, the rest having been requested by different members of the executive. In this respect we suggest that the legislative branch of government has omitted to derive all the benefit that was desirable from this body of representative scientific men. The president of this academy, in his annual reports, states fully any action taken by the academy each year, at the request of either branch of the government, but with a very delicate spirit offers no advice or comment not called for by the strict letter of the official requests. An act amending the act of 1863, and adding thereto a section requiring the president of the academy to make an annual report to congress on the present state of all national works bearing on science and its applications, with such recommendations as may have the sanction of the whole academy, would give this important body of men an opportunity to speak on behalf of scientific co-workers throughout the country, which opportunity is now offered only through some special request. A further amendment to said act, authorizing the academy at any time to communicate to either house of congress its views on the bearing of any proposed legislation without waiting for special request, would give the country assurance that the scientific, educational, and other interests of the country have at length an official representative who will be on the alert to defend their interests, and to avert injurious legislation. We believe these two amendments would go far towards providing a high tribunal, whose vigilance would insure greater wisdom in legislation; but the following third step is even more important. It is difficult for many outside of Washington to realize that any one who is an employee of the executive branch cannot, without incurring a reprimand, officially or privately approach any legislator with a view to influence legislation:

the law and the custom are quite strict upon this point. Occasionally a bold man will evade or break through diplomatic etiquette; but, as a rule, those members of the academy who happen also to be members of the executive are greatly hampered in any efforts to improve the relations between government and science. We therefore believe, that, before congress can obtain the free, untrammelled judgment of some of the best members of the national academy, it must relieve them individually and collectively from the operation of this objectionable law, and confer upon academicians liberty of speech on matters pertaining to the scientific policy of our national legislature. This great privilege, granted because of their recognized experience and the impossibility of otherwise obtaining the advice of the very men whom congress needs and has accepted as advisers, should be made a duty, and may possibly eventually bring with it a further condition; i.e., the membership of the academy, which is at present wholly a matter of election by its own members, might be in some way ratified by the senate so that congress may feel that its advisory academy is wholly in sympathy with itself. We conclude, then, by expressing the belief, that without a single abrupt immediate change in the relations of the scientific bureaus and offices of government, without any immediate revolution in the executive departments, without taking from any of the present chiefs his right and liberty to conduct the work committed him to the best of his knowledge and ability, but by three or four simple steps, we may quietly secure for the legislative branch of government such enlightenment and conservative advice as will eventually and rapidly lead to an improved and economical execution of the works now in hand; will insure satisfactory relations between science and the government; will assure the stimulation of scientific education and work, and the strengthening of the hands of such as honestly desire to promote the welfare of the people, rather than the creation of an aristocracy of government officers, or the execution of some petty personal scheme. X.

SCIENCE.

FRIDAY, APRIL 24, 1885.

COMMENT AND CRITICISM.

The work of the commissioners of the state reservation at Niagara has advanced to the point that the bill making the appropriations for taking the necessary lands has passed the legislature, and only awaits the signature of the governor. There comes a suggestion from Mr. S. A. Lattimore of Rochester, to the effect, that, in the event of the acquisition of the land around the falls by the state, a museum should be erected there, to be devoted exclusively to the elucidation and explanation of the physical and geological history of the place. Its walls should be built of rocks from local quarries; its rooms should contain only such objects as possess a true scientific value; mere curiosities, and specimens from other regions, should be carefully excluded; every thing should have as direct a bearing as possible on the history of the falls. Samples of the famous rock series from the gorge, with its fossils and minerals; plants and animals from the neighboring country; and maps and models of the falls and the chain of great lakes, — constitute the chief parts of the museum as described by its projector.

The plan is certainly a good one, and may be successfully carried out at no great cost. Such a museum could be made attractive as well as instructive, and few visitors would fail to see and profit by it. The exclusion of curiosities, such as too often encumber museums, is well advised; but to our mind the collection needs two additional elements in order to reach its full value, — waterfalls and gorges in other parts of the world should be illustrated by views, maps, models, and descriptions, so that the inquiring stranger might gain a true estimate of Niagara; and the exhibit should be described in some detail on the labels. Few collections that are open to the public have sufficient explanation accompanying them; and visitors are, as a rule, forced to be discontented with mere names instead of reading well-stated meanings of what they see. Such descriptive labels might even be supplemented by brief papers prepared by specialists, and accessible to the small share of visitors who care to make some study of the place. We commend Mr. Lattimore's project to the careful consideration of the commissioners.

On April 16, Gov. Harrison (who is now *ex officio* a member of the Yale corporation, and who was, until his election as governor, one of the corporators elected by the Yale alumni) signed the bill by which the state of Connecticut terminated its contract with the Yale observatory for furnishing standard time. The legislation on this subject has had a history which strikingly illustrates the danger of having scientific institutions depend on popular assemblies for annual appropriations for their support. When the 'standard time' law was enacted, in 1881, Connecticut had its full quota of local times. The confusion in that manufacturing and busy community was so marked, that the Yale observatory had comparatively little difficulty in guiding an exceptionally able legislature to a unanimous decision in regard to establishing a standard time. The observatory, with an admirable plant, has conducted the service with uniform efficiency and accuracy.

To the surprise of its officers, some two months since, the appropriation committee reported to the Connecticut house of representatives a bill repealing the appropriation by amending the original act. This report was made without a single hearing on the merits of the case. When it became known that the committee intended to push the report, the friends of the observatory, and those interested

in the service, made a determined effort to defeat it, which was only so far successful as to defeat it in the senate once of the three times it was there considered after leaving the house of representatives, where it was passed by a small majority. By some it is believed that the whole proceeding originated in republican party warfare against the 'mugwumps' and free-traders at Yale college. This much is certain, that the ordinary friendliness which might exist between the college and the state was lacking in the case of many members of the general assembly. The governor, who was known to be personally strongly in favor of the observatory service, found himself in a delicate position, and doubtless, in the absence of any thing unconstitutional in the repeal, took the only course open to him which would be open to no misconstruction.

PROFESSOR JAMES GEIKIE of Edinburgh contributes a very valuable article on the physical features of Scotland to a recent number of the new Scottish geographical magazine. It is illustrated by a beautiful little orographical map of Scotland by J. Bartholemew, in which the physical relief is finely brought out. Commenting on this, and on the excellent maps of the Ordnance survey on which it is based, Professor Geikie concludes with the following paragraph: —

"With such admirable cartographical work before them, how long will intelligent teachers continue to tolerate those antiquated monstrosities which so often do duty as wall-maps in their schoolrooms? Surely more advantage ought to be taken of the progress made within the last thirty or forty years in our knowledge of the physical features of our country. It is time that the youth in all our schools should be able to gather from their maps an accurate notion of the country in which they live; that they should see the form of its surface depicted with an approach to truth, and learn something more than that so many principal rivers flow in so many different directions. With a well-drawn and faithful orographical map before him, the schoolboy would not only have his labors lightened, but geography would become one of the most interesting of studies. He would see in his map a recognizable picture of a country, and not, as at present is too often the case, a kind of mysterious hieroglyphic designed by the enemy for his confusion."

We copy this with hearty emphasis and approval, for it points out precisely the difficulty under which our scholars labor. But while in Great Britain, and in continental Europe generally, the surveys from which good school-maps might be constructed are already well advanced or completed, in our country they are either neglected or only just begun; and it is even still almost always a difficult matter to persuade state legislators, from whom appropriations flow, that good maps are needed. It is no exaggeration to say that the educational value of such maps as are now in preparation in New Jersey and Massachusetts is alone more than their cost to the state; and we shall watch for the better teaching in the common schools, that must follow their completion, with as much interest as for the inception of similar work in other states.

LETTERS TO THE EDITOR.

Centrifugal force and the supposed polar ice-cap.

IN your issue of March 27, you publish an article by Dr. Franz Boas, upon 'Mr. Melville's plan for reaching the north pole,' in which there are some statements that should not pass unchallenged. They occur in the discussion of the effect, upon the supposed 'ice-cap,' of centrifugal force due to the earth's rotation.

The formula for calculating the effect of centrifugal force is a well-known and simple one, $C = \frac{wv^2}{32.16r}$, in which v = velocity in feet per second, r = radius in feet, w = weight of the mass acted on, and C is the centrifugal force in pounds. Apply this to latitude 85°, r = 345 miles, or 1,821,600 feet, and $v = 132\frac{1}{2}$ feet per second.

Then, if we take a cubic foot of ice, $C = \frac{1}{60}$ of a pound, or about one hundred grains of pull, away from the pole, southward, upon each cubic foot of ice, — a force which is approximately one four-thousandth of the weight of the body acted upon, instead of being thirty thousand times that weight.

Whether the ice is one foot thick, or one hundred feet in a single block or in a broad or heaped mass, makes no difference in the result; for each unit of mass acts independently of each other unit. So far as centrifugal force goes, it could neither make nor mar the hypothetical 'ice-cap.'

E. W. WETMORE.

Essex, Conn., April 11.

In the controversy between Mr. Melville and Dr. Boas respecting the supposed polar ice-cap, both parties appear to take an erroneous view of the action of 'centrifugal force.'

The notion of centrifugal force, like other examples of the so-called 'force of inertia,' is used simply to enable us to treat a body whose particles are not all moving uniformly in straight lines as in statical equilibrium. Thus, by imagining a force following a certain law of intensity acting outwardly from the earth's axis, in co-existence with the force of gravity, we may regard the earth as a stationary body, subject to these forces. It is the resultant of these forces which we commonly regard as the force of gravity; and, the earth having assumed the form of equilibrium, with a surface everywhere normal to this resultant force, there is no more occasion to consider the centrifugal force as acting independently. But, if we choose to do so, then we must regard the radial force of gravity as acting also; and the centrifugal force acting at any point is then balanced by the force which would, if the earth were not in rotation, reduce it to a spherical form. Thus the centrifugal force can create no tension in an ice-cap, and there is nothing in the nature of the forces acting to interfere with the existence of a continuous ice-cap round the pole, whether symmetrically situated or not. Of course, if a mass of ice were piled up at the pole above the spheroidal surface of equilibrium, lateral pressure would exist, but only in the same way that it would under like circumstances in any other part of the earth; and, wherever this pressure met insufficient resistance, the ice would 'flow' away in glaciers, just as it does from any elevated region of the earth's surface. WM. WOOLSEY JOHNSON.

Digestion experiments.

An agricultural experiment-station has to contend against the prejudices of a public which demands speedy work and preposterous generalizations rather than accuracy. When a station, therefore, does do work of a scientific character, it is especially desirous of recognition on the part of science, as such recognition not only brings encouragement to the workers, but also has an influence upon the public to educate toward better expectations and wiser demands. What suggests this remark is an article in *Science*, April 10, entitled 'Errors in digestion experiments,' from which the reader would infer that Professor Armsby's experiments upon digestion were the only ones of that character which have been made in this country. As a matter of record, however, I presume the New-York agricultural experiment-station, in its Bulletin No. lxxxv., May 17, 1884, is entitled to the claim of having first published the results of a trial upon the digestibility of a ration in part composed, in the one case, of corn-fodder, and, in the other, of the same material ensilaged. In the forthcoming report of the station for 1884, the figures of these trials, as well as of others, will appear in considerable detail.

E. LEWIS STURTEVANT.

Geneva, N.Y., April 13.

Volcanic dust from south-western Nebraska.

There were received at the national museum a few weeks since, from a gentleman in Nebraska, samples of a fine white and very sharp dust, supposed by the sender to be of geyser origin. The deposits from which the samples were taken are stated to be semicircular in outline, from four to ten feet in thickness, and of varying grades of fineness, situated on the banks of small streams that flow into the Republican River. The precise localities given are, Furnas county, two miles south of the Republican River, in sections 9 and 10, township 3, north range 21 west; and Harlan county, one mile south of the river, sections 10 and 11, township 2, north range 20 west; though the writer states that he has also found similar deposits in Kansas, Colorado, and Wyoming.

An examination of the dust with a microscope shows at once that it is not of Geyser origin, being composed almost wholly of minute fragments of pumiceous glass, with only very rarely a small particle of hornblende. Portions of a coarser deposit, associated with the dust, contain numerous rounded fragments of felspar, a part of which at least is triclinic, as shown by twin striations, and hornblende and magnetite particles. The deposits are therefore, without doubt, volcanic dust and sand, owing their present arrangement to the assorting agency of water and atmospheric currents; and their mineral composition would indicate that the corresponding lava was an andesite.

The matter is deemed of sufficient importance to mention here, from the fact, that, so far as I am aware, no deposits of dust of this nature have heretofore been reported east of the Rocky-Mountain region. GEORGE P. MERRILL.

U. S. nat. museum, April 13.

Hastings's theory of the corona.

Your reviewer of the 'Report of the eclipse expedition to Caroline Island' has, by an unfortunate expression, so entirely misrepresented my theory regarding the solar corona, that a correction is necessary. Instead of supposing that the "coronal phenomena may be fully accounted for by applying the well-known principles of diffraction," as he asserts, I demonstrated that these principles completely fail to account for any part of them. What I did do was to prove that Fresnel's theory is not applicable to the case where both source of light and screen are at an indefinitely great distance from the observer; for then the implied constancy of phase of the wave-surfaces certainly does not exist. This limitation of the theory of diffraction does not seem to have been noted before; and it necessarily implies a distribution of light about the moon during a total eclipse which may be like that of the corona. Assuming that the corona is so formed, I show that all its characteristics (with the exception of the occasional filamentous structure, where the indication of the theory is doubtful) may be explained naturally and easily, even the polarization and absence of the Fraunhofer lines.

I may venture to describe briefly two observations of interest given in detail in the report, since they have not been noted in the review, and have been published only in the report. The first is Professor Holden's observation of the so-called 'shadow-bands' seen just before and just after totality, and which so strikingly suggest a diffraction phenomenon. No one before him, so far as I know, has determined with any useful precision their azimuth, nor had it before been recognized that they move in opposite directions at the two epochs. That their azimuths are those of planes tangent to the sun at the points of second and third contacts, is perhaps not of such immediate interest as the observed reversal of motion, since the latter feature excludes the more favored explanation which makes them shadows.

The other point is the proof that the '*b*' group must be regarded as belonging to the same category as 1474 K, the hydrogen lines H and K; namely, that of bright corona lines. This renders it extremely probable that all the brilliant as well as high chromospheric lines are also coronal lines. The fact must be regarded as a strong indication in favor of the theory advocated. C. S. HASTINGS.

New Haven, April 13.

THE CONSOLIDATION OF THE GOVERNMENT SCIENTIFIC WORK.

OUR readers are already aware that the congressional committee appointed to consider the organization of the surveys and other scientific work of the government made no report at the last session of congress. The commission was, however, continued as a commission of the succeeding congress. The expired places of Messrs. Pendleton and Lyman were filled by new appointments from the members elected to the next congress. A meeting of the reorganized body has been held, which adjourned until next November without coming to any definite conclusion respecting the measures to be finally proposed. Before adjourning, Major Powell was authorized to make public the testimony which he had laid before them on different occasions, and which covers most of the points to be acted on by the commission.

Major Powell's statements naturally include a very detailed account of the methods, work, organization, and expenses of the survey over which he presides. He also submitted his views upon the best method of consolidating the geological and coast surveys with the other scientific bureaus of the government. This is the really important question before the commission, since upon its decision must turn the general efficiency of the government scientific service for a long time to come. The necessity for some such consolidation is strongly felt in congress as well as outside of it. The one danger to be avoided is that of some hasty plan being adopted, which may suit the exigencies of the moment, but may not work well after those exigencies have passed.

One very strong reason for placing the scientific bureaus under one head, or in one department, is that scientific work has many features peculiar to itself, which require it to be conducted upon principles different in some respects from those which prevail in other departments. The head of an ordinary bureau or department of the government, and indeed every man in public life, is conversant only with offices and duties which there is no serious difficulty in satisfactorily filling, with the aid of that knowledge of men and of the world which he acquires through his daily intercourse with others. Such a person is accustomed to finding scores of candidates for every office, from whom a suitable selection is always possible. The idea of an office for which there may be no applicants, or, if there are any, for which it is morally certain that the applicants are all unfitted, no matter how good their recommendations, is one which he finds it difficult to assimilate. Indeed, in the case of the purely scientific office, the ability to find the proper men must be a part of the life education of the man who is to make the selection. It is safe to say that the best officers who have served in the coast and geological surveys are men, who, under the ordinary system of government appointments, would never have been heard of in connection with the positions which they so ably fill.

The same thing is true of the administration of a scientific bureau. No uniform system can be devised which will apply to all the details of a great scientific work. When we go beyond the regular routine operations, it is needful that the duties shall be accommodated to the man, and that in many cases a larger measure of liberty shall be allowed the latter than could be tolerated in the usual operations of a government department. All this requires, on the part of the administrative head of the department, an appreciation of the subject which can only be acquired by long familiarity. If the head is not specially charged with mastering the peculiar methods of administration thus rendered necessary, the chances are that he will fall into one of two opposite errors: either he will leave the heads of the scientific bureaus to manage things in their own way, without any administrative control whatever, or he will exert his authority in such a way as to endanger the efficiency of the work. The former is undoubtedly the more natural course to take, and thus arise the friction and duplication of work which so seriously impair efficiency and discipline.

Yet another feature of government scientific

work is that it is far removed from that public criticism which is so conducive to efficiency in other branches of the service. It is difficult to conceive that such a state of things as was exhibited by the surveys of the territories ten years ago could have existed in the performance of any work with which the public were conversant. At that time we had at least two independent surveys of the territories, prosecuted by different departments of the government, and with nominally different objects, but which were practically identical in their actual work. The officers in charge were independently surveying and mapping the very same regions. At the time that Hayden's Atlas of Colorado was published, Capt. Wheeler was engaged in surveying Colorado, and making maps of the territory substantially identical in their objects with those of Hayden. Both surveys were intended to cover the whole public domain.

Nothing quite so bad as this is likely to arise in the future. But there is still room for much duplication of work, as well as waste through competition in getting possession of particular fields. As a general rule, the head of a department is quite ready to approve of any extension of work which any of his bureau officers may propose, and has not always time to learn that the same work is being done, or might be better done, by some other department. The annual provision which congress has got into the habit of inserting into the appropriations for the signal-office — "provided that hereafter the work of no other department, bureau, or commission authorized by law shall be duplicated by this bureau" — is not quite satisfactory: it leaves open the question whether any proposed work is "the work of any other department, bureau, or commission."

The report of the National academy of sciences proposes to remedy some of these evils by placing the general policy of the scientific bureaus under the control of a mixed commission, organized somewhat after the plan of the Lighthouse board. If the bureaus are to remain separate, we see no better plan than this for securing the proper co-ordination of their work; but Major Powell points out certain difficulties in the way of its successful operation. His strongest objection is, that subordinate officers of various departments would have to practically control the work, thus reducing the heads of the departments to channels for transmitting instructions. If the proposed commission were to assume any administrative control of the work, this objection would certainly be fatal. The official responsibility of the head of a department for the work of his bureaus should not be interfered with. But the report of the academy expressly disclaims charging the commission with any administrative responsibility. Its sole function was to prescribe the policy of the bureaus; that is, to decide what each one should do, and what each one should refrain from doing: the whole execution of the work decided upon being left completely in the hands of the regular authorities. We see no reason why this should be 'irksome' to the heads of the departments. We also feel that Major Powell assigns undue importance to the influence of the single military officer proposed by the academy as one of the nine members of the commission. It is not so clear to us, as it seems to be to him, that one such officer could leaven the whole lump of the commission with ideas of military discipline unsuitable to the conduct of a scientific bureau.

But however favorably we may view the plan of this commission, we must hold that the consolidation of the bureaus under a single head, or in a single department, would give far more assurance of efficiency. Especially is this the case with the two national surveys. Their work now covers the same fields, and their mutual interdependence is such that they should work under a common plan. The geological survey requires for its proper execution certain geodetic and astronomical work, the execution of which is not within the proper province of the geologist. It is absolutely necessary that this geodetic and astronomical work should be so planned and executed as to meet the wants of the geological survey, and

at the same time it is the proper function of the geodetic survey. We are informed by Major Powell that he makes use of all the coast-survey results so far as they are available, but he does not indicate what fraction of his labor is thus saved; and it goes without saying, that he has no authority, directly or indirectly, to require that the coast and geodetic survey shall do any thing which he may want done.

Among the suggestions made by Major Powell was one that all the scientific bureaus should be placed under the general direction of the regents of the Smithsonian institution. This does not appear to have been considered practicable, and was not further urged by the director himself. One of the possible plans is to place all these bureaus under the interior department. The principal objection to this course is that that department is already overloaded with work, so that its head could not give the proper consideration to the subject. Yet this is the simplest course, and would certainly be an improvement on the present state of things. The more effective course would be to form a separate department of science and public works. To this there seems to be no positive and serious obstacle, except the difficulty of getting any measure of the sort enacted into a law. The question whether the head of the department should be a scientific expert or a public administrator, is an ulterior one, which need not be discussed at present. In the latter case, the question of its being regarded as a cabinet office would arise. There will be little hesitation in deciding this question in the negative.

In a future number we hope to discuss other testimony taken before the commission, and the proposition which appeared in the supplement to our last number.

THE BOTTLE-NOSE DOLPHIN, TURSIOPS TURSIO, AS SEEN AT CAPE MAY, NEW JERSEY.

This is the commonest dolphin on our Atlantic coast, occurring from Greenland to at least as far south as Florida; and Professor Flower is inclined to believe that it is cosmopolitan. The dolphins are very abundant along the shore of New Jersey, passing and re-passing close to the beach in schools of greater or less magnitude. The fishermen state that they usually pass around Cape May City into Delaware Bay upon the rising tide. Their movements would appear to be somewhat uncertain, however; for we lay all the morning at Hereford Inlet, expecting to see them approach from Seven-mile beach, and failed, but found them in the afternoon at Cape May point, from which we had started. It seems probable that they come into Delaware Bay from the southwest.

The school surrounded at Cape May point apparently comprised about thirty individuals. They showed no fear at the approach of the steamer. Upon striking against the large net in which they were impounded, they showed no disposition to leap over it, but attempted to make their escape by diving. Observations on this point, however, were brought to a speedy close from the fact that three specimens, becoming entangled in the net, rolled it up from the bottom, and thus allowed the remainder of the school to make their escape.

All the three specimens secured were females: two were adult, about two hundred and sixty centimetres in length, and the third a young animal about a hundred and twenty centimetres in length. On compressing the sides of one of the larger specimens, milk issued in a fine stream from the mammae. When collected in a bottle, it appeared of the color and consistency of cream, was without perceptible odor, and possessed the flavor of cocoanut-milk.

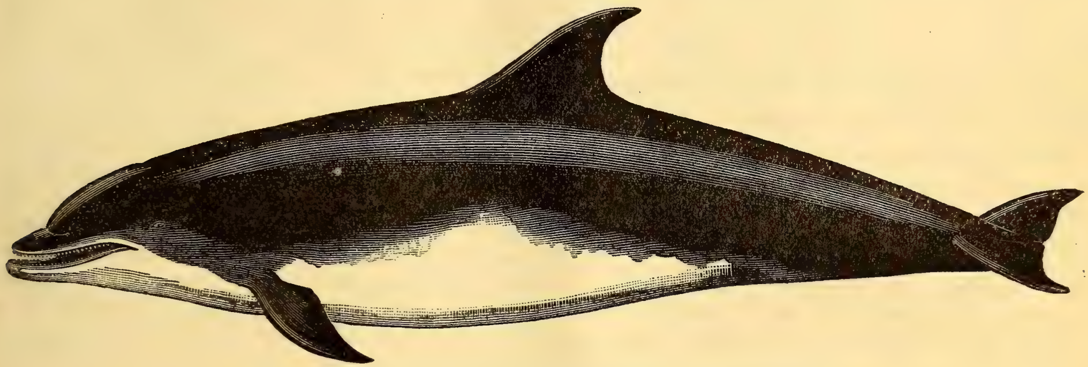
I placed some in a bottle to bring to Washington for analysis, but it soured in transportation on account of the warmth of the weather, and forced out the cork. The fishermen stated that the specimen which furnished the milk was followed about by the younger animal. Although I was not near enough to verify this observation, it seems to me very plausible. The teeth of the calf were barely visible above the gums, and it showed other signs of youth. I am inclined to believe that it was born in the spring of 1884, and that the time of weaning was not far distant when it met its death.

Upon opening the abdomen of the second adult specimen, we found a foetus about twelve centimetres in length. The stomach of both adults contained simply a few bones and one or two skulls of a fish which appeared to be

the common gurnard (Prionotus carolinus). The specimens having been drowned, the lungs were filled with water. The fishermen state that this species cannot remain under water more than four or five minutes.

The color of the back in the specimens secured was a light plumbeous tint. It shaded rather suddenly at the middle of the sides into the pure white of the under parts. I was informed that the depth of the color of the back varied considerably in different specimens, and it deepens very rapidly as soon as life is extinct, especially if the specimens lie in the sun. FREDERICK W. TRUE.

National museum, Washington.



THE BOTTLE-NOSE DOLPHIN, TURSIOPS TURSIO (AFTER FLOWER).

BUTTER.

THE work of the U. S. bureau of agricultural chemistry shows that the percentage of water in a good butter should not exceed twelve. In thirty-four analyses the highest percentage of water found was 14.51, and the lowest 7.34. It is naturally in the interest of the seller to incorporate as much water as possible in the butter. But, if all butter should be legally condemned which should contain more than ten per cent water, the tendency to 'underwork' the butter would be speedily corrected. In one instance a report of an analysis of foreign butter gave a percentage of water of 35.12. The quantity of salt in a butter should depend solely on the taste of the consumer. I doubt very much whether the addition of a few per cent of salt helps preserve the butter. It is therefore a condiment only. In eighty-four analyses the highest percentage of salt found was 6.15, and the lowest 1.08. Two per cent is a fair mean of the salt usually present. Much butter is now made without any salt at all, and the use of such butter is rapidly increasing. Salt is cheaper than butter, and there is therefore a tendency to use it to the maximum endurable by the eater. But butter without salt will hold more water; and, as soon as this fact is generally known, sweet, moist butter will be more common than the dry, salt article. It would be a good thing if all the caseine could be washed out of the butter, but this is impracticable. Albuminous bodies decay more easily than all others, and butter with a great deal of curd in it is very hard to keep sweet. Of all the constituents of butter, this is the most difficult to estimate. Oleomargarine butters contain no curd, unless they have been churned with milk, and even then not a great deal. If butters do not have more than one per cent of curd, they may be accepted as having been properly prepared. Owing to the difficulty of estimating it, however, the quantity present should not be taken as a test of purity.

The fat of genuine butter is heavier than that of tallow, lard, or any of the common fats used as butter adulterants. Its specific gravity is about 912, water at the same temperature being taken at 1,000. The relative weight of tallow or lard often falls below 900. In analyses of commercial oleomargarine I have found the highest density to be 905. Of butter-fats in thirty analyses the maximum was 912.5, and the minimum 908.6. There should be grave doubt of the purity of a butter, if the specific gravity of the fat should fall below 909. For this reason the specific gravity of a butter-fat, if it be properly taken, is almost a certain test of its genuineness. The process is, however, a tedious one, and requires the greatest care and delicacy in manipulation.

The quantity of alkali required to saponify the fat is another valuable means of judging of the purity of a butter. This equivalent is an abstract number obtained by dividing the molecular weight of the alkali employed by the number of milligrams of it used in saponifying a given weight of the fat. Butter-fat contains acids (butyric chiefly) which have a lower molecular weight than oleic, margaric, and palmic acids. The saturation equivalent of a butter-fat is therefore expressed by a smaller number than if it were composed solely of glycerides of the acids with a higher molecular weight. The determination of the equivalent being an easy one, it is generally made as the first test in determining the genuineness of a butter sample. For genuine butters, this number is about 245. When it goes above 250, the samples should be regarded with suspicion. In one case of a Jersey butter very rich in butyric acid, this number fell to 239.8. On the other hand, in four samples of tallow, lard, and oleomargarine (two), the numbers were 280, 284, 282, and 281 respectively.

Pure butter contains a certain proportion of glycerides of fat acids soluble in water (butyric, capronic, caprylic, etc.). The percentage of these acids to the total weight of butter-fat is about five. In thirty analyses the lowest percentage found was 4.49, and the highest (except in one case) 5.66. In the case of the Jersey cow's butter, already mentioned, this number was 6.79. Tallow and lard have at most only a trace of these acids. In commercial oleomargarines the highest percentage found was .56, and the lowest .20. The determination of the soluble acid requires much time; but it is not a difficult operation, and it is the most certain method of determining the purity of a butter. A sample which would give no more than four per cent soluble acid would be open to condemnation. It would either be a very poor sample of genuine butter or else an adulterated article.

Pure butter which has not been melted gives, with polarized light and a selenite plate, a pure uniform tint of red or blue to the field of vision. Adulterated butter in similar circumstances always gives a mottled appearance to the field. This is a very simple and speedy qualitative test for the purity of butter, but is not sufficient in itself to definitely determine the matter.

The difficulties which make the analyses of milks of little practical value are equally as great with butter. A more extensive study of their composition, however, is certain to lead to profitable results. H. W. WILEY.

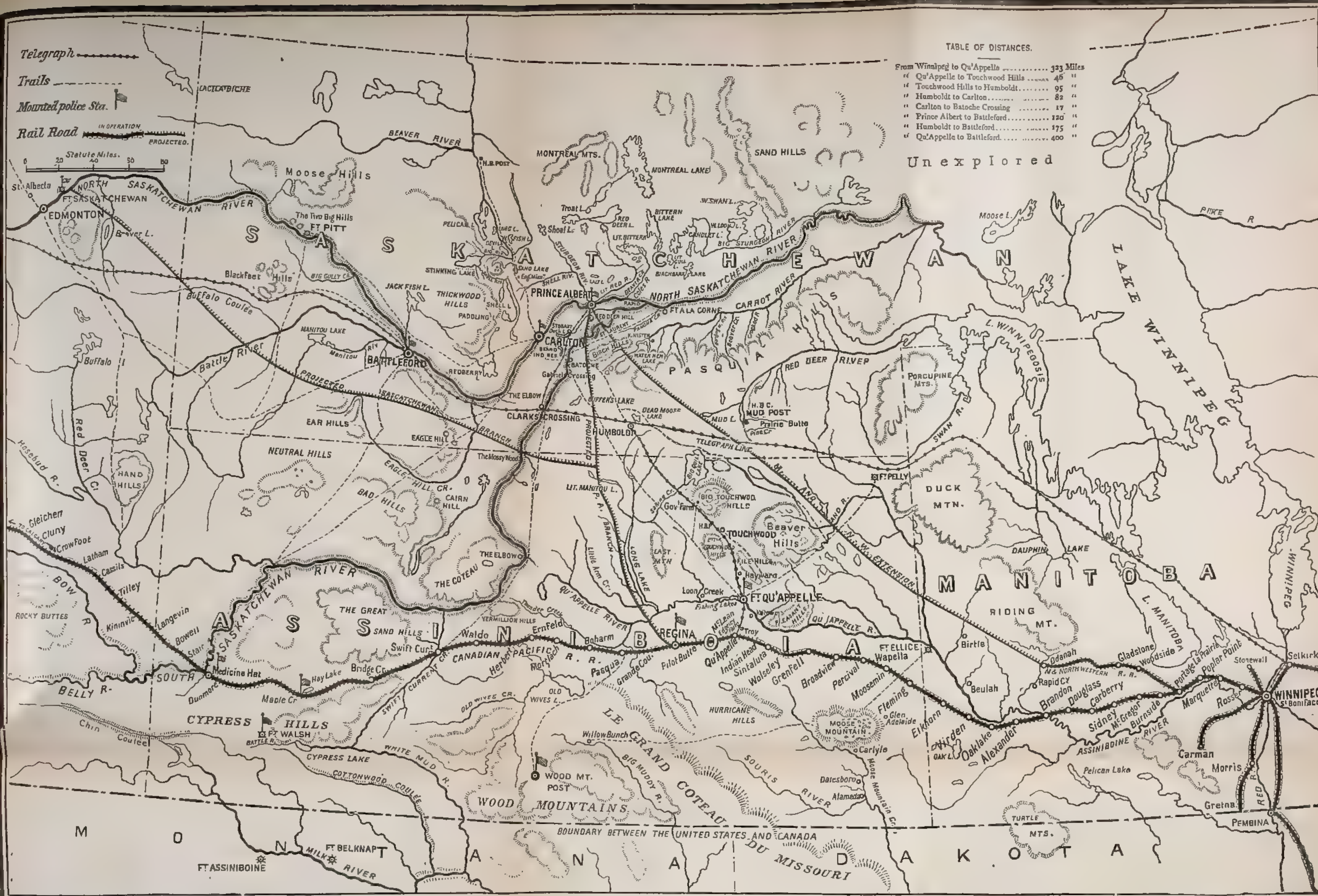
THE SASKATCHEWAN COUNTRY.

THE district at present attracting attention as the scene of an insurrection of half-breeds and Indians against the Canadian government is situated on the North Saskatchewan River, near the northern margin of the great plains. The vast region of plain and prairie, which occupies the whole central portion of the continent, crosses the 49th parallel of latitude — which constitutes the international boundary-line — with a width of 750 miles, but extends north of the boundary about 300 miles only, being there limited by the edge of the great northern forest which stretches, with little interruption, to beyond the arctic circle. Prairies of considerable size occur, it is true, in the valley of the Peace, but these are isolated from the great plains by wide forests. There is reason to believe that the greater part of the prairie country in Canadian territory might become permanently wooded but for the almost annually recurring prairie-fires, which are still tending to increase its area. The southern edge of the forest is, however, in the main, coincident with that of a region of abundant rainfall.

The northern border of the prairie country may be generally defined by a line drawn from the vicinity of the city of Winnipeg westward to the junction of the Assiniboine and Qu'Appelle rivers; thence north-westward to the junction of the North and South Saskatchewan rivers; thence westward, nearly following the latter river, to Edmonton; from that point south-westward to Calgary, on the Bow; and thence southward along the eastern base of the Rocky Mountains. The total area thus outlined, which is either altogether treeless or characterized by wide stretches of prairie interspersed with scattered groves of aspen and other trees, is approximately 300,000 square miles. The southern and south-western parts of this region may be described as entirely without wood, though even there the rivers are almost invariably fringed by groves of cottonwood.

The general elevation of the plains of the Canadian north-west is very considerably less than that of the corresponding portion of the continent farther south, the mean height of the whole region above outlined being probably less than two thousand feet above the sea-level. The most pronounced inclination, however, giving direction to the rivers of this portion of the great plains, is that from the base of the Rocky Mountains to the east or north-east. The Red-River valley, which constitutes the


Telegraph
Trails
Mounted police Sta.
Rail Road
Statute Mile
0
20
40
TABLE OF DISTANCES.
Winnipeg to Qu'Appelle 323 Miles
Qu'Appelle to Touchwood Hills 46 "
Touchwood Hills to Humboldt 95 "
Humboldt to Carlton 82 "
Carlton to Batoche Crossing 17 "
Prince Albert to Battleford 120 "
Humboldt to Battleford 175 "
Qu'Appelle to Battleford 400 "
nexplored
St. Alberta
NORTH
FT. SASKAT
EDMONTON
Moose L.
A
N
LAKE WINNIPEG
PIKE R
L. WINNIPEGOSIS
Buffalo
RCUPINE
MTS.
SWAN R.
Red Deer
Rosebud R.



Reproduced from map published by Burland Lithographic Company, Montreal.

SCIENCE, April 24, 1885.

MAP OF THE SASKATCHEWAN REGION, SHOWING POINTS OCCUPIED BY THE REBEL HALF-BREEDS AND INDIANS.

lowest prairie-level, and lies along the base of the eastern Laurentian plateau, has an altitude of about eight hundred feet only. From this level, with minor exceptions, the surface may be regarded as sloping gradually and continuously upward, at a rate of from four to five feet in the mile, to the foot-hills. There the horizontal and unaltered strata of the cretaceous and Laramie formations break against the base of the ancient rocks of the mountains into a series of sharp and nearly parallel flexures, producing a varied and picturesque region, with quite peculiar characters. In the central portion of the plains, the most marked exceptions to their generally even and monotonous contour are found in the tumultuously hilly belt of country known as the Missouri Côteau and in a line of diffuse and indefinite elevations nearly parallel to the Côteau, which includes Turtle Mountain, Moose Mountain, and the File and Touchwood Hills. These hills, or mountains so called, are really tracts of considerable size, with rolling or hilly surface, more or less wooded. The northern extension of the Côteau, where known as the Eagle Hills, near Battleford, also becomes partly wooded.

To any one familiar with the territory lying west of the Missouri, the most remarkable difference of a general character, observable in this northern extension of the same region, is perhaps the extraordinary abundance of small lakes, ponds, or 'sloughs,' which are scattered everywhere over its surface. This peculiarity is evidently in connection with the mantle of glacial drift, which is here universal, and dependent on the irregular deposition of its material. The lakes and ponds, while at times arranged in intercommunicating linear series, are usually distributed without the least apparent regularity, and occupy shallow basins without outlet. Filled by the melting of the snow or rains of the early summer, a great proportion are completely emptied by evaporation before the autumn, while the water remaining in others becomes more or less distinctly saline in many instances. This is more particularly the case with those of the southern and more arid portion of the region. Near the northern margin of the plains, saline lakes are quite exceptional. It is generally on the edge of one of these rush-bordered pools that the traveller makes his evening camp; and, while the abundance of water in one respect facilitates travel in the spring and early summer, the moist condition of the deep alluvial soil at these seasons may prove a more than countervailing disadvantage. The most serious obstacles, however, to be met with in long journeys across the plains, are the various rivers. The Assiniboine, Souris, Qu'Appelle, and other streams of the eastern district, during the breaking-up of the ice, and for some time subsequently, may prove formidable barriers in the absence of bridges or ferries. The North and South Saskatchewan, the Red Deer, Bow, and Belly rivers, all eventually uniting to pour their waters into the northern end of Lake Winnipeg, rise far back in the Rocky Mountains, and, while subject to considerable spring freshets in some seasons, are generally not in full flood till June or July, when the snow is disappearing from the highest summits of the range, and the snow-fields and glaciers about the sources of some of them are melting most rapidly. These streams have trenched valleys across the surface of the plains, which are generally from a hundred to three hundred feet in depth, and a mile to two miles or more in width. All the trails used as regular means of communication make for recognized crossing-places on these rivers, where the approaches are favorable, and where very generally the river may be forded at low water, though ferries of some kind have usually of late years been established for use at other seasons.

As above indicated, almost all the larger river-valleys hold more or less timber; and in the northern part of the region this is not confined to the bottom-land, groves and thickets spreading also into the lateral valleys ('coulées') and broken ground which is very generally to be found in the vicinity of these great river-troughs. Should any serious opposition be offered to the expeditions now on their way to quell the present unfortunate disturbance, it will in all probability be at one or other of the 'crossings' which naturally lend themselves to defence. The rivers, as might be expected from the considerable general inclination of the surface, are usually rapid and shallow, with numerous gravel-bars, and reefs of bowlders, at low water. They are often, moreover, extremely tortuous; and in consequence of these peculiarities, and the considerable portion of each year during which they are icebound, they are not extensively utilized as means of communication; and trains of wagons or Red-River carts are still generally employed in travelling, or in the transport of supplies and goods at a distance from the railways. The Hudson-Bay company has, however, for a number of years, used a couple of small stern-wheel steamers between the Grand Rapids, near Lake Winnipeg, and Edmonton, far up on the North Saskatchewan. Two or more steamers

of the same class have quite lately been placed on the South Saskatchewan; and it is proposed to employ these in the present emergency in carrying supplies from Medicine Hat, where this river is crossed by the Canadian Pacific railway, to the vicinity of Prince Albert.

This portion of the interior of the continent was reached in the days of the fur companies, either by the canoe route from Lake Superior, or by ascending the Nelson River from York Factory on Hudson Bay; and it was by the first-mentioned that Sir Garnett Wolseley, with his little force, penetrated to the valley of the Red River in 1870. When St. Paul had become a commercial centre, the Hudson-Bay company began to bring the greater part of its goods from the south; while in later years the police-posts, settlements, and cattle-ranches established in the far west were supplied from Fort Benton, on the Missouri. The Canadian Pacific railway, pushed with unexampled rapidity from Winnipeg across the plains, and completed to the summit of the Rocky Mountains about eighteen months ago, has, however, completely changed the old lines of travel. The time-honored trail from the Red River by Forts Carleton and Pitt to Edmonton — a journey of nearly nine hundred miles, requiring, with loaded carts or wagons, under the most favorable circumstances, nearly forty days — need no longer be followed. The points above mentioned, with other isolated little settlements of more recent date along the North Saskatchewan, are now reached by new trails from the nearest stations to the south on the railway; and a system of telegraph-lines, constructed and operated by the government, unites the more important of them. After leaving the railway, however, the distances to be traversed in the old-fashioned way, before the more remote settlements are reached, are still very considerable. Thus to Carleton and Prince Albert, from Qu'Appelle station, the trail-distances are 228 and 253 miles respectively; from Swift-Current station to Battleford, 202 miles; and from Calgary to Edmonton, 191 miles.

The length of this note does not admit of any detailed description of these and other main roads. It may be remarked, however, that while the trail from Qu'Appelle toward Carleton and Prince Albert, as far as the crossing of the South Saskatchewan, is generally through an open country, groves and belts of aspen are not infrequent in its vicinity. The longest stretch quite without timber is that known as the salt plains, about thirty miles only in width.

The country in the vicinity of Carleton, Prince Albert, and Duck Lake, is rolling, or characterized by low hills with numerous and in some cases extensive groves ('bluffs') of wood. The settlement is of a scattered character, but for the most part confined to the point of land between the two branches of the Saskatchewan, the total population being probably about three thousand.

At the crossing of the South Saskatchewan, by the trail from Swift Current to Battleford, there is a good ferry. This trail, to within about twenty miles of Battleford, is entirely destitute of wood. Battleford was at one time selected as the seat of government of the Northwest territory, but, since the definite location of the railway, has been abandoned in favor of Regina. There are scattered settlements of half-breeds and whites in the neighborhood, and several Cree Indian reserves. The trail from Calgary to Edmonton crosses the Bow, Red Deer, and Battle rivers, and several smaller streams flowing from the foot-hills and mountains. Ferries exist where necessary; and, should these not be destroyed, a rapid advance by this route would be easy. For sixty miles there is no wood on this trail: beyond that point timber is abundant. Edmonton is a somewhat important centre, with a number of little settlements of whites and half-breeds subsidiary to it.

George M. Dawson.

THE GLOW-LAMP.

It was stated not long ago that the number of incandescent lamps in this country alone is over one hundred thousand. Such a success as this warrants a glance at the history of the lamp, which is given by A. Gelyi in the *London electrical review.*

While the arc-lamp emits twenty-two hundred candle-light per horse-power, and the glow-lamp gives but a hundred and twenty, it is the possibility of so reducing the light to a minimum that has brought the latter system forward; for, although it is true that the arc-light may be considered capable of a division into lamps of intensities varying from twenty to ten gas-flames, that minimum is in many cases, especially for domestic purposes, a great deal too high, whilst the regulating apparatus is expensive.

But two substances are known which possess such properties as are indispensable for the production of the glow-light; namely, platinum and its alloy with iridium, and, secondly, carbon. The former has the advantage, that, when heated to whiteness, it does not consume away even in the air: but, in a no less important respect, that metal is far behind carbon, for it is by no means capable of sustaining such a degree of heat without fusing; and this is of vital

importance, for the quantity of light emitted by a glowing substance rises in a more rapid proportion than the temperature of that substance.

In 1838 we find Professor Jobard of Brussels saying that "a small strip of carbon in a vacuum, used as a conductor of a current of electricity, would emit an intense, fixed, and durable light." De Changy, a former pupil of Jobard, seems to have taken these words as advice, for he commenced his experiments in that line almost immediately afterwards. About this time an Englishman named Moleyns also made an incandescent lamp by using platinum. DeChangy's experiments failed because the strips of gas-carbon which he used became disintegrated by the current, and, as his globes were not perfectly exhausted or sealed, the carbon gradually consumed away.

About the year 1843, J. W. Starr of Cincinnati entered upon a thorough study of the light, and found in Peabody a munificent promoter of his plans. After helping Starr in every way, Peabody sent him to England to exhibit his invention. Before starting on his voyage, Starr procured himself a companion named King, a shrewd man of business, who immediately had a large chandelier constructed with twenty-six electric glow-lamps, which were to symbolize the states of the Union. The novel spectacle was gazed upon by large crowds; and Faraday, after witnessing the experiments, signified to his American brother electrician his great satisfaction with the result.

Starr died on the return voyage, and King patented the lamp in his own name. This patent was granted on the 4th of November, 1845, and refers to 'a glowing carbon strip in a vacuum.' But with the death of Starr the necessary funds ceased to flow, and in a short time the promising glow-lamp was consigned to oblivion.

A very similar fate befell the inventions of the Englishmen Greener and Staite, who patented, in 1846, another carbon-lamp. Starr formed the necessary vacuum by using a tube thirty-six inches long, filled with mercury; but the generation of electricity was at that time far too expensive, although as regards the clearness of the light, and the durability of the carbon, the lamp was a success.

In 1849 Petrie proposed to patent the use of iridium, but the scarcity of that metal rendered it out of the question. In 1855 DeChangy resumed his studies with renewed zeal, occupying himself with the construction of a lamp in which platinum formed the conductor, and in 1858 patented a current regulator which enabled him to use his lamps for the illumination of mines, submerged for fishing-purposes, and in a nautical telegraph system by which signals were displayed from the mast-heads of vessels. The platinum was submitted to a preparing process of separation, being maintained heated for some time at a moderate degree of redness, and then gradually raised to that degree of heat to which it would be afterwards subjected in the lamp.

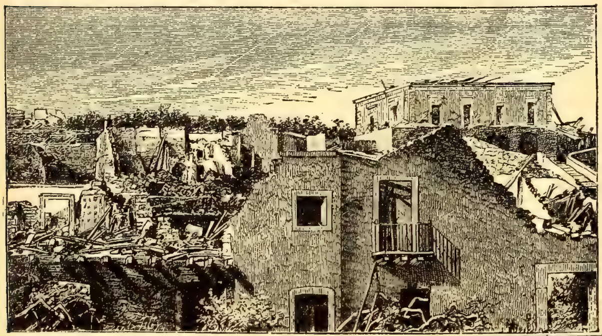
At intervals of ten and fifteen years after the inventions of Starr and of DeChangy, the incandescent lamp was revived, with partial success; but it was not until Edison and Swan put their shoulders to the wheel that a perfect and practical lamp was constructed.

In the year 1878 Edison was journeying in the Rocky Mountains, when a companion awakened within him the desire of occupying himself with electric lighting, and on his return to Menlo Park he furnished himself with the necessary apparatus. Like DeChangy, he imagined that it would be easier to use metal than carbon; and, with the abundant funds furnished him by the Edison electric-lighting company, he was enabled to reach almost every substance which his fertile brain might suggest. For instance: it is said that his attention was called to thorium, — a metal particularly difficult to fuse; and, when a mineralogist informed him that there was not a half-ounce of thorium in the whole territory of the United States, Edison called up one of his assistants, and, telling him that in one of the gold-mines of the north-west a quantity of monarite crystals (from which thorium is extracted) had been found, gave him a letter of credit, with instructions to bring him in the shortest possible time a hundred pounds of monarite. In a few weeks Edison had the monarite, and forthwith began his experiments. But thorium also failed; and platinum was again tried, this time with a certain amount of success.

Meanwhile the dynamo-machine and the Sprengel air-pump had been perfected. An Englishman named J. W. Swan now obtained fair results with a filament of charred cardboard, and found that the rapid consumption and consequent breaking of the glowing carbon was an almost insuperable impediment to his success, and he also found that the inner walls of his lamp became darkened by a deposit of some kind. These troubles must have been of a most alarming character. But Swan went on, and obtained the co-operation of a Mr. Stearn, who was considered a great authority as regards perfect vacuum. Evidently he also fully understood that the carbon must be previously heated to whiteness in a good vacuum; and in 1877 he sent to Mr. Stearn a quantity of carbonized cardboard strips, requesting that they be mounted in glass bulbs, subsequently to be exhausted as perfectly as possible. This seems to have been done with rare ability by raising the carbon to a very high degree of heat by means of an electric current, which set free the gases it contained, and afterwards removed them. The ends of the filaments were also made thicker; and when the connections were made good, and the vacuum sufficient, the glass bulb containing the glowing carbon did not blacken, and the consumption of the filament was infinitesimally small. There only remained to make the lamp mechanically perfect; and in 1878 Swan publicly exhibited his glow-lamp, which possessed all the essential characteristics of that in use at present. In the same year Edison discarded metals, and followed in the footsteps of the carbon men. Being forestalled by Swan, Mr. Edison could not use cotton thread in his lamp, and, after a long series of experiments, decided upon the use of filaments made out of a species of bamboo.

A TYPHOON IN SICILY.

In the early morning of the 7th of October, 1884, Etna was seen to be covered with a mantle of clouds, which spread themselves in a north-west direction. At eight o'clock there was a barometric depression throughout the whole western part of Sicily, the mercury falling two millimetres. During the typhoon, which began at about noon, the barometer registered 761.1 millimetres, whereas in the morning at nine o'clock it stood at 761.8 millimetres. The normal average is 762.5 millimetres. The thermometer at nine o'clock was 22.5° C., and during the storm went up slightly. The relative humidity at nine was 0.78, but at noon had risen to 0.88. At eight o'clock the wind was from east-north-east, blowing gently, and at noon was from the south-east. At 12.30, near the Passo Portese, 18 kilometres from Catana, a dark cloud in the form of a spout was seen to form. The rotary movement was opposite that of the hands of a watch, and the spout travelled across the country from west-south-west to east-south-east at the rate of 28 kilometres (17 miles) per hour. It frequently raised itself above the ground for some moments, and then again touched the land to complete its devastation. When near Ognina, it left the land and went to sea, where it died out. The noise produced by the storm has been compared to that caused by many trains of cars passing over an iron bridge at high speed. There were very few flashes of lightning, and only two reports of thunder loud enough to be heard above the storm. Hailstones of great size fell on the northern border of devastation, causing much damage. They were very rough, and some were as large as oranges. One weighed 300 grams. The zone of greatest devastation was about 27 kilometres in length (not including the 5 kilometres at sea), with a breadth of 350 metres. Twenty-seven inhabitants were killed, and five hundred wounded. Many houses were destroyed, trees torn up by their roots and carried away, and in one place a piece of lava weighing 8 kilograms was thrown through a window 10 metres from the ground, while another pierced a house like a bullet.



A VIEW NEAR CATANA AFTER THE TYPHOON.
(From *La Nature.*)

EFFECTS OF THE TYPHOON IN A CATANA OLIVE-GARDEN.
(From *La Nature.*)

CREEPING OF RAILS.

It has been observed by those having charge of railroad-tracks, that in some places the rails move longitudinally, or 'creep.' On double-tracked lines the rails tend to move in the direction of the traffic; but on single-tracked roads the alternating direction of the trains will naturally neutralize this tendency. Again: on long inclines or grades the track may creep down hill, — a phenomenon which is reasonably attributed to expansion and contraction from successive changes of temperature, the rails slipping in the direction of least resistance; that is, expanding down hill, and contracting up hill. In both cases there is generally little difficulty in arresting the movement by driving spikes into the ties through the notches provided for this purpose, either in the rail-flanges at or near their ends, or in the angle splice-bars so commonly used at joints. The rail often exerts considerable force against these spikes or bolts, and has been known, in some instances, to partially cut or shear them off. The thrust is resisted by the ballast in which the ties are bedded.

A curious instance of rail-creeping, which it is difficult to explain, was given in the *Railroad gazette*, Dec. 5, 1884, where it is stated, that on a piece of single track on the New-York and New-England railroad near Hartford, Conn., a part of which was level, and the rest on a grade of twenty feet per mile, with an equal number of trains each way, one rail moved down hill five feet and one inch in the course of a year, and the other moved eighteen inches in the reverse direction. It has been suggested that the spikes in the two ends of the ties or sleepers may not have been properly alternated, thus allowing the ties to turn horizontally from the correct position at right angles to the rails.

That the elastic yielding of the ballast under the passing loads, and the slight rocking of the ties, absorb or resist the creeping force, would appear from the fact that the tendency to creep is most pronounced where the supports under the rails are held rigidly, as in bridges. On the Harrisburg bridge, over the Susquehanna, the Pennsylvania company encountered this difficulty, but arrested the movement by spikes through the angle-splices at joints. On the St. Louis arched bridge, and its east approach, there is found a most remarkable example of creeping rails. Prof. J. B. Johnson, in a paper read before the Engineers' club of St. Louis,[1] discusses this case at length, and offers an explanation.

The bridge proper is 1,600 feet long; the east approach, a series of short girders on iron columns, is 2,500 feet long, with a grade rising towards the bridge of eighty feet per mile; both are double-tracked. As it was thought by those in charge of the bridge that fastenings at frequent intervals, to resist the movement, would bring too great a strain upon the structure, the attempt was made to restrain the rails by holding them firmly at isolated points some distance apart, with the result that spikes, bolts, and splice-bars were sheared off or torn apart. After the failure of attempts to arrest the creeping, the track was cut at the two abutments and at the east end of the east approach. The time of eight men (five by day, and three by night) is stated to be largely occupied in changing rails at these points. Where the openings are enlarging, short pieces of rail are taken out, and longer ones put in their place: where the openings are closing up, the process is reversed. Each operation is performed many times a day, and a careful record is kept, from which the following facts were obtained: the north track, when carrying an annual westward traffic of about 5,283,000 tons, moved west on the approach and up-grade 401 feet in a year, and on the bridge moved 264 feet; the south track, under an eastward traffic of 4,807,000 tons, crept east 414 feet on the approach, and 240 feet on the bridge, in the same time. The movement each way on the bridge was proportional to the tonnage; and the difference on the approach was doubtless due to the grade, as the changes of temperature would produce a slipping down hill, as previously stated.

Professor Johnson cites some explanations of this case that have been given: viz., the stopping of trains on the bridge; the deflection of the bridge itself by the weight of the train; the distortion of the arch, as a train enters a span, by its curve becoming less convex on the loaded portion, and more convex on the unloaded side, with a reversal of the distortion as the train passes over and off the span, the arch thus slipping under the rails; and, finally, the elastic rolling-out and recovery of the rails under successive wheels, as we may imagine a strip of rubber to move as a roller is passed over it. He does not think, however, that these causes are sufficient to account for so great a movement, and, in explaining his theory, offers a preliminary illustration. Suppose a span of a bridge to have supports exactly alike, such as sliding surfaces, at the ends of the bottom chord, and a train to enter upon it. The bottom chord is stretched by the action of the load, and, as the end where the engine enters is held fast by the added weight, the other end must slip on its support in the direction of the train movement. As the cars pass off at this latter end, and hold it fast, the lower chord shortens, and recovers itself at the first bearing by slipping towards the train. Thus the bridge creeps in the direction of the moving train. If the points of support were under the upper chord, the direction of this creeping would be reversed. When rollers are placed under one end, and the other is anchored fast, the slip and recovery take place on the rollers, and no creeping results.

He notes that between the trucks of every car the rail springs up from the support an appreciable distance, by reason of the elasticity of its bearings, and that, when pressed down by the passage of the rear truck, any marked point on it has advanced a small distance. A wave-motion of the rail may be perceived in advance of every wheel, and an increment of forward movement every time a wheel passes. The more cars, the more movement for any train. The rail moves across the bridge by reason of the extension under flexure of the flange on which it rests. In proof of his position, he showed, by a model over which a loaded wheel was rolled, that a rail supported by the bottom flange will creep forwards, and that the same rail, when supported by its head, will creep backwards; and hence he argues that some point of support between the head and the bottom flange may be found, for which the tendency to creep shall be zero.

[1] Journal of the Association of engineering societies, November, 1884.

THE PATRIARCHAL THEORY.

In 1861, Sir Henry Maine's work on 'Ancient law' was published. In that work he clearly set forth the importance of 'legal fictions' in the development of institutions. In this respect, his work will remain as a permanent contribution to the science of society. In the same treatise he made an exposition of the patriarchal theory of the origin of society, which had long been held by a class of writers in Europe. In his introduction he says, —

"This evidence establishes that view of the race which is known as the patriarchal theory. This theory is based on the scriptural history of the Hebrew patriarchs. All known societies were originally organized on this model. The eldest male parent is absolutely supreme in his household. His dominion extends to life and death, and is as unqualified over his children

The patriarchal theory. Based on the papers of the late John Ferguson McLennan. Edited and completed by Donald McLennan. London, *Macmillan*, 1885. 16+365 p. 8°.

as over his slaves. The flocks and herds of the children are the flocks and herds of the father. These he holds in a representative rather than in a proprietary character."

Subsequently 'Village-communities in the east and west,' 'Lectures on the early history of institutions,' and 'Dissertations on early law and custom,' were published, in which Maine still advocated the patriarchal theory. Arguments for this supposed origin of society were derived from the history of the Romans, Greeks, Hindoos, Celts, Teutons, Slavonians, and Hebrews.

In 1868 the Smithsonian institution published Morgan's great work on 'Systems of consanguinity and affinity of the human family;' and in 1877 his work on 'Ancient society' appeared. In these, and in miscellaneous articles published in the reviews, Morgan clearly and fully established the existence of more primitive forms of social organization than those exhibited in the Scriptures and early Roman history. Thus the patriarchal theory fell to the ground. Morgan's investigations extended far and wide among the lower tribes of mankind, and his work altogether constituted a masterpiece of inductive research.

But we now know that Morgan's work had one blemish. Seeing that the growth of family institutions, which constitute a large part of primitive sociology, was in the main toward a higher state of society as measured by the standard of civilized ethics, he accredited savage peoples with modern opinions relating to physiology, and with a high degree of moral purity, and held that the growth of institutions was due to a conscious effort at reform. While, therefore, Morgan's theory of the structure of primitive society was established on abundant facts, his theory of the origin of this structure and the cause of its development was unsound. Thus it occurred that a theory of the structure of society resting upon an inductive basis was to some extent discredited because of *a priori* theories of social and moral reform. Inductive conclusions suffered by reason of their association with deductive errors. For these reasons certain scholars in Europe, and especially in England, have to some extent ignored Morgan, and have gone on to re-affirm and elaborate the patriarchal theory. Chief among these is Sir Henry Maine.

J. F. McLennan, the author of 'Primitive marriage,' and other works on tribal society, collected a great body of facts relating to marriage by capture, and the interesting formalities which supervene upon that institution, and from them deduced the theory of exogamy and endogamy, by which he classified the tribes of mankind into exogamous and endogamous, and thus failed to discover that exogamy and endogamy are correlative parts of the same institution. McLennan was evidently dealing with facts more primitive than those with which Maine was dealing, and, soon discovering the errors into which Sir Henry had fallen in his patriarchal theory, he finally commenced the preparation of a critical treatise on that subject, probably for the purpose of clearing the ground for the more elaborate treatment of his theory of marriage and concomitant theories of tribal kinship. He died before his work was completed. His brother, Donald McLennan, has taken up the subject, and edited the papers, adding new material. The book which we now have before us is the result, and is a very fine piece of destructive criticism. The entire field occupied by Sir Henry Maine is reviewed; and the facts from Aryan and Semitic history are carefully examined, and shown to be quite contradictory of Maine's theory. He shows, further, that the particular form of patriarchy discovered among the Romans, and which Maine claimed to have been the universal form, was exceptional, and that the Roman tribes presented the sole instance. To American anthropologists this work may seem one of supererogation; but it will serve a good purpose by clearing the ground of false theories which have had deep root, and have been continually springing up to choke the growth of sounder doctrines.

In this new book by the McLennan brothers, the destructive part is much more satisfactory than the constructive: in fact, the critical portion is somewhat marred by erroneous theories relating to primitive marriage, and by some strange blunders relating to kinship, — blunders common to many writers on sociology.

It seems probable that a form of social organization based upon communal marriage was primordial; but, be that as it may, it must here be neglected. It has been established that a very early form of society was based upon kinship, and that kinship was used to organize peoples into groups of different orders. In the very simplest form, there is always a larger group including two or more smaller groups. In this grouping, kinship of one kind is used to combine the individuals of a smaller group into a minor body politic, and kinship of another kind to combine the groups into the larger body politic. Thus the group in its various orders depends upon the recognition of different kinds of kinship. To make this plain, it becomes necessary to define

the kinds of kinship recognized in primitive society. First, then, kinship by consanguinity and kinship by affinity are clearly distinguished. Then kinship by consanguinity, or 'cognation,' as designated in Roman law, is divided into parts. The consanguineal kindred of any given person may constitute a large body. There may be selected from this body all of those persons whose kinship may be traced exclusively through males. Such kinship was called by the Romans 'agnation,' and the body of included kindred, 'agnates.' From the same body of cognates there may be selected all those who can trace their kinship exclusively through females. Let such kinship be termed 'enation,' and the body thus constituted, 'enates.' The agnates and enates together constitute but a part of the whole body of consanguinei or cognates. In all tribal society, either the agnates or the enates are clearly distinguished from the other cognates, and organized into a body politic, usually called the clan or gens.

Maine holds in that primitive society agnation was the only kinship recognized, and that enation is an accidental and infrequent derivative; that the true course of kinship development is from agnation to cognation. McLennan holds that in primitive society enation only was known; that agnation is an accidental and infrequent derivative; and that the true course of evolution is from enation to cognation. The fact is, that cognation, including enation and agnation, is primitive; that is, that no society has yet been discovered among the savage tribes still living on the globe, or in recorded history, that has not recognized cognation in its different branches; and in all cases different kinds of kinship have been used for different organizing purposes.

In the simplest form above mentioned, where the group constituting a tribal state is organized into sub-groups, sometimes the higher group is bound together by affinity and general cognation, while the smaller group has a kinship bond of enation. And, again, sometimes the higher group is bound together by affinity and general cognation, while the smaller group is organized on agnation. In either case, the tribal bond is affinity with cognation; and in like manner the clan bond is either agnation or enation. The evidence that cognation has been recognized in all tribal peoples, is complete. Not a single tribe has yet been found to ignore it in its social organization; and, in every language that has been investigated, kinship terms for it are discovered. The real question, therefore, is not whether agnation or enation is the more primitive, but whether agnatic kinship or enatic kinship was the tie which bound together the members of a clan or smaller group in the tribal organization. Sir Henry Maine and the McLennan brothers alike have failed to discover this, one of the most patent facts concerning primitive institutions; and this failure has led both parties into the most radical errors.

There is another institutional principle which seems to be primordial; at any rate, it is everywhere woven into primitive custom-law. This principle will here be called 'elder-rule.' It would seem that primitive men in the savage state, groping for some means to prevent controversy and secure peace, hit upon the very obvious expedient of giving authority to the elder; so that, in all the relations of life, superior age should confer authority.

There are thus two primordial principles in early law: the first is that kinship by affinity and consanguinity is the bond of society; and the second is that authority inheres in the elder. These two principles have been worked out in many and diverse ways, and about them have gathered many legal fictions; but they were primordial, and have been universal down the whole course of history, including the highest civilization; so that even now affinity and consanguinity, both agnatic and enatic, together with elder-rule, still continue, — the one as the bond of the civilized family, and the other as its rule of authority. But the history of the application of these principles is long and varied.

The Roman patriarchate was defined by agnation; and the group was a body whose kinship was reckoned only through males, and over whom the patriarch, who was the highest male ascendant, was the ruler. This ruler had despotic power. He owned his wife, and by legal fiction reckoned her as the elder sister of his daughters. He also owned his sons, and his sons' wives, and their children, and was the owner or custodian of all the property belonging to the group. This is *patria potestas*. The patriarchy, therefore, is a despotic form of elder-rule exercised by the eldest ascendant over a group of agnatic descendants. On the death of the patriarch, the group was dismembered into as many parts as there were sons with families. The patriarchal group, therefore, was dissolved and re-organized with every passing generation.

There is another form of elder-rule, which I shall denominate 'presbiarchy,' in which the ruler is the oldest man of the kinship group,

whether that group be agnatic, enatic, or cognatic. Such a group does not necessarily dissolve on the death of the ruler, for the next younger man who is the oldest of the group takes his place. The group, therefore, is comparatively permanent, and there is no inherent necessity for its dissolution. It may remain as long as there is a living man to act as ruler. Presbiarchy has widely prevailed: in fact, it seems to be primordial.

The patriarchy, with its *patria potestas*, as far as we now know, was confined to the Roman tribes: but the patriarchy without absolutism has been much more widely distributed, and it has probably been associated also to a greater or less extent with presbiarchy, real or fictitious; so that the latter has frequently been divided into patriarchies, they being subordinate groups.

Maine and the McLennan brothers seem not to recognize presbiarchy; and Maine, wherever he discovered evidences of it, and also where he discovered evidences of any other form of elder-rule, presented them as proof of the existence of the patriarchy. Had the McLennans recognized elder-rule, they could have made their criticism of Maine much more effective. As it is, they have successfully attacked Maine's theory by showing that *patria potestas* has not been widely spread; in fact, that there is no evidence of its existence, except among the Romans.

Maine also bases his theory of the primordial and universal patriarchy upon his theory of agnation; and, wherever he discovers a recognition of agnation, he holds that it is evidence of the patriarchy with *patria potestas*. The McLennans show that agnation is not the only kind of kinship recognized in tribal society, by arraying much evidence of the recognition of enation; but they themselves fall into the antipodal error of supposing that enation was the only kind of kinship recognized.

Altogether the patriarchal theory of Maine has been successfully overthrown in the work before us, by a re-examination of the very facts adduced in its support; and we owe a debt of gratitude to the authors for the thorough way in which they have accomplished their task. If, now, Sir Henry Maine will on his part as completely overthrow the McLennan theory of exogamy and endogamy, and its concomitant polyandry, the ground will be well cleared for the development of a sound system of sociology upon the inductive basis established by Morgan.

Connected with this theory of the patriarchy is Spencer's theory of ancestor-worship, by which he accounts for the genesis of theism, — a theory which ignores all the facts of savage philosophy, finds an origin for opinions midway in the history of culture, and accounts for later opinions as following in the course of normal development, and for early opinions as degeneracies. With the final overthrow of the patriarchal theory, the ancestral worship theory has its weak foundation entirely removed. A piece of good destructive criticism here would be opportune.

Spencer's ghost theory of the origin of a dual existence has long been overthrown by Tylor's grand induction denominated 'Animism.' A good piece of destructive criticism on this point also would be timely.

J. W. Powell.

LESQUEREUX'S CRETACEOUS AND TERTIARY FLORA.

This work is the third, and will undoubtedly be the last, of the series of final reports contributed by this author to the publications of the U. S. geological survey of the territories in charge of Dr. Hayden, and which together constitute a truly great and enduring monument to the fame of the now venerable paleobotanist. The first of these volumes appeared in 1874, and was devoted to the flora of the Dakota group, the only cretaceous flora then known in the west. The second, a larger work, came out in 1878, and was called the 'Tertiary flora;' but more than half of it was taken up with species of the Laramie group, by many regarded as cretaceous. The present volume is in the nature of a review of the whole field covered by the two preceding, bringing the matter down to date, and embraces some Pacific-slope miocene localities in addition.

The first hundred and twenty pages and eighteen plates are devoted to a revision of the flora of the Dakota group, and the description and illustration of thirty-five new species from that formation. At the close of this division of the work, the author introduces an exhaustive table of distribution, extending it to embrace the entire Cenomanian formation, to which he assigns the Dakota group, as well as the middle cretaceous of Greenland. He divides the Cenomanian of Europe into three groups of localities: viz., 1, Moletein, Quedlinburg; 2, Quadersandstone, Harz, Bohemia;

Contributions to the fossil flora of the western territories. Part iii. The cretaceous and tertiary floras. By Leo Lesquereux. Report of the U.S. geological survey of the territories. F. V. Hayden, U.S. geologist in charge. Vol. viii. Washington, *Government*, 1884. 12+283 p., 59 pl. 4°.

3, Niederschoena, Saxony, Hungary. Some of these districts are exceedingly vague; 'Quadersandstone,' for example. Niederschoena is in Saxony; and Quedlinburg is in the Harz district, at the same horizon as Blankenburg, which is not Cenomanian at all, but Senonian. From all these sources he enumerates 442 species, — a number which is still too small. The Dakota group alone furnishes 195 species.

The second division of the work relates to the Laramie group, but does not review its flora. Some dozen additions to it, made by Mr. Lakes at Golden, Col., are described, six of which are new species. Mr. Lesquereux here discusses again the geological position of this group, and, while still insisting upon its eocene character, admits that its flora resembles that of the travertines of Sézanne in the Paris basin, but which are known to lie considerably lower than the coarse limestone and lignites that prevail in that district. In his table of distribution he only enumerates 207 species; but the reason for this paucity is his failure to recognize as Laramie the plants described from the Fort-Union group, — the upper Missouri and lower Yellowstone region, and the Bad lands of Dakota.

The third division of the work consists of an exhaustive survey of the flora of the Green-River group; and, as this had not previously been done, it forms altogether the most valuable part of the treatise. Since the appearance of the 'Tertiary flora,' a large amount of material from this formation had accumulated in the author's hands, out of which he obtained no less than ninety new species. The most fertile source of this material was the small locality in South Park, Col., known as Florissant, from which, in a light volcanic ash, also containing insect-remains, an immense number of beautifully preserved specimens of fossil plants have been derived. The other principal localities grouped under the general designation of 'Green-River group,' are those of Green-River Station and Alkali-Stage Station, Wyoming; Elko Station, Nev.; and a place reported as in 'Randolph county.' As to this last, as there appears to be no Randolph county in any western territory, it is probable that Randolph courthouse, Rich county, Utah, is meant, which is the same as is otherwise known as Bell's Fish-Cliff, where fine specimens of palm-leaves and other fossil plants are found. The locality called Barrel's Springs is also here referred to the Green-River group, although it appears in the preceding table as belonging to the Laramie group. This is confusing, to say the least.

We have not space to show how the floras of these several localities are correlated by the author; but the occurrence of identical and wholly characteristic species in several of them seems to establish their geological synchrony with considerable certainty. This formation is now commonly regarded as eocene; but Mr. Lesquereux, led, as in the case of the Laramie, by the affinities of the flora with that of Europe, insists upon placing it somewhat higher, and calls it 'oligocene.'

The remainder of the work is devoted to what is called the 'miocene flora.' So far as the localities on the Pacific slope (Chalk Bluffs and Corral Hollow, Cal.; John Day valley, Ore.; and Alaska) are concerned, this reference is doubtless correct; but the large collections from the 'Bad lands of Dakota' belong almost without question to the Fort-Union group, and should have been referred to the Laramie, with which the invertebrate fauna forces us to correlate that group. It is true that this flora has a marked miocene aspect when compared with those of European strata, and that several species seem to have persisted from that period to the present (e.g., Corylus Americana, Onoclea sensibilis); but the entire Laramie flora is also strongly miocene, and at least one species (Ginkgo biloba, L.) of the living flora has come down to us seemingly unchanged from the typical Laramie of Point of Rocks, Wyoming.

Geological considerations aside, this volume is one of the most important that have lately appeared upon the paleontology of western America, and, should it prove his last work, would fittingly crown the long and faithful labors of its justly celebrated author.

ANTHONY AND BRACKETT'S PHYSICS.

FOR many years the English have borrowed or stolen their text-books of elementary physics from the French, and Americans have borrowed or stolen from the English. About a year ago, Daniell produced a distinctly English, or rather distinctly Scotch, book of this order. Now Professors Anthony and Brackett have undertaken to remove America's reproach. Their book is to consist of two parts, of which part i., 'Mechanics and heat,' has already appeared. It is a small volume, and in other respects shows a disregard of old traditions. It has numerous diagrams, but hardly a *picture*.

Elementary text-book of physics. Part i. Mechanics and heat. By Prof. W. A. ANTHONY and Prof. C. F. BRACKETT. New York, *Wiley*, 1884. 9 + 246 p. 12°.

It gives almost at the start a short treatment, much shorter than Daniell's, of simple harmonic motions; and it devotes several pages to the idea and theorems of potential. The subject of air-pumps, and with it much that is wont to make the student miserable, is dismissed after a treatment of four pages. In the chapters devoted to heat we miss the familiar names of Dulong and Petit, and the other pre-Regnault investigators of the phenomena of expansion. The steam-engine occupies one page, without an illustration. Carnot's cycle, with related matters, fills ten pages.

The book is written with great care. Its language is clear and judicious. There are, of course, slight inaccuracies. For instance: the first sentence of article 26 reads as if a point could be located by means of its distance from any one plane. Again: on p. 209 we find it stated as having been demonstrated experimentally by Joule, that, "when a gas expands without performing external work, it is not cooled;" the later experiment of Joule and Thomson, which led to a different conclusion, not being mentioned.

From beginning to end, this volume of Anthony and Brackett grapples with difficult principles boldly and in good faith, as if the authors expected their whole book to be read and mastered. Trigonometry is freely used, and occasionally something that borders on the calculus. The long experience of the authors as teachers encourages the hope that they have not over-estimated the capacity of college classes; but, excellent as is the matter and the manner of the book, one fears that the ordinary student will find portions of it formidable.

Perhaps it should not be otherwise. Certainly the extraordinary student, who craves strong meat, will find it here, and of the best. So small a book cannot teach all there is to learn: it is not intended to do so. It does not show the whole of physics, but it shows physics as a whole.

NOTES AND NEWS.

DURING the opposition of Neptune just passed, Professor Pickering continued the observation of the planet's magnitude with the meridian photometer of the Harvard-college observatory in the same method as previously employed. Nine series of observations extend from Dec. 16, 1884, to Jan. 21, 1885, the final result from which, when corrected for atmospheric absorption, instrumental error, and reduction to mean opposition, becomes 7.63. The residual difference for only one series is as great as two-tenths of a magnitude. The corresponding results for two previous seasons are 7.71 and 7.77. Contrary to the experience of Mr. Maxwell Hall of Jamaica, who found evidence for a rotation-period of Neptune in small variations of the planet's light according to his own observations, Professor Pickering regards it as improbable that there is any variation in the light of Neptune of a strictly periodic character, and further calls attention to the influence, much neglected by observers, upon the observed brightness of objects when seen east and west of the meridian on the same night. This has to be taken account of in the observations of maxima and minima of many variable stars, and may to some extent account for the variations of Neptune's light detected by Mr. Hall.

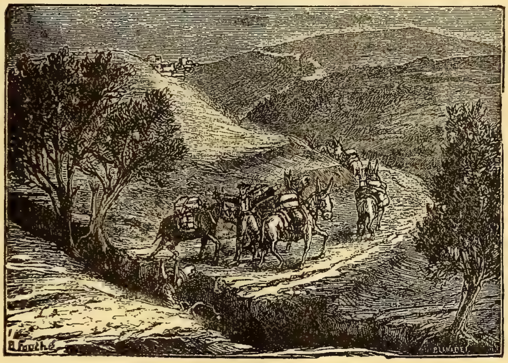
—Prof. Charles E. Bessey writes to the *American naturalist* that fifteen years ago there were no dandelions in the Ames flora (in central Iowa): now they are very abundant, and have been for half a dozen years. Then there were no mulleins: now there are a few. Then the low and evil-smelling Dysodia chrysanthemoides grew by the roadside in great abundance: now it is scarcely to be found, and is replaced by the introduced 'dog-fennel' (Anthemis cotula). Then the small fleabane (Erigeron divaricatum) abounded on dry soils: now it is rapidly disappearing. Then no squirrel-tail grass (Hordeum jubatum) grew in the flora: now it is very abundant, and has been for ten years. Then there was no burr-grass in the flora: now it is frequently found, and appears to be rapidly increasing. Both of these grasses have apparently come in from the west and north-west. Fifteen years ago the low amaranth (Amarantus blitoides) was rather rarely found: now it is abundant, and has migrated fully a hundred and fifty miles north-eastward. This plant has certainly come into the Ames flora from the south-west within the last twenty years. Old settlers say that there have been notable migrations of plants within the past twenty or thirty years. The buffalo grasses of various kinds were formerly abundant in the eastern part of the state: now they have retreated a hundred to a hundred and fifty miles, and have been followed up by the blue-stems (Andropogon and Chrysopogon). The blue-stems now grow in great luxuriance all over great tracts of the plains of eastern Nebraska, where twenty years ago the ground was practically bare, being but thinly covered by buffalo grasses. In Dakota it is the same: the blue-stems are marching across the plains, and turning what were once but little better than deserts into grassy prairies.

—A principle that may generally be wisely adhered to by reviewers is that notices of books appearing in numbers should not be based on the first number issued; but this can be safely departed from in announcing the preparation of a new (fourth) edition of Meyer's 'Konversations lexikon,' of which the first part appears with imprint of 1885. Sixty-four pages carry it to 'Absteigung.' Abyssinia is allowed six and a half pages, which include liberal reference to sources of information, an essential in all good encyclopaedias. Among the illustrations there are

chromolithographed plates of African tribes and of the Alps, both finely executed. The work is to run through two hundred and fifty-six weekly numbers.

— Mr. A. Ainslie Common, well known as the maker of a powerful reflecting-telescope at Ealing, Eng., has been experimenting in the application of photography to the production of stellar maps. A small lens of four inches and a half diameter has been found sufficient to show stars of the ninth magnitude; and one of the photographs of the region about *Altair* (α Aquilae) was found to contain eighteen hundred separate stars which had been identified.

— Messrs. Hachette have just published vol. x. of the 'Nouvelle géographie universelle' of Elisée Reclus, which shows the same amount of care and energy as its predecessors. The maps are as numerous as ever, and the illustrations, nearly all taken from photographs, are excellent. This volume deals with the basin of the Nile, and thus embraces regions in which the public are just now specially interested. Mr. Reclus furnishes full accounts of the physical geography of the country, and of its inhabitants, but very wisely abstains from discussing the political events of the day. The information has been well brought down to date, documents published as recently as November, 1884, having been consulted.


THE CREVASSE ON THE ROAD FROM LOJA TO ALHAMA, SPAIN. (From *L'Astronomie*.)

— The Natal *Mercantile advertiser* gives a lengthy account of the expedition of Dr. Aurel Schulz in the interior. One strange tribe discovered by the party on the Kabengo River, was the Makuba tribe. They are strongly aquatic, taking to the water like fish, splendid fishermen, well built, strapping fellows of Zulu type, expert canoeists, and the corn-growers of the country-side, and, in addition to all this, imbued with a horror of shedding human blood, so much so that a man of the outside blood-shedding tribes is always 'open to back himself to give battle to fifty Makubas any day.' Another interesting matter is the account of the chief Kama, who rules at Soshong, the capital of the northern Bechuana. He governs his people well: his great wish is to have them well armed with guns, and provided with ammunition. Alcohol in any shape is not allowed in his dominions. No kafir beer is brewed. Any white trader selling liquor is fined up to a hundred pounds; any subject brewing is expelled from the country. All, from the chief downward, are stanch teetotalers. Kama claims dominions up to the Tyobe River, though those portions do not pay tribute. He gives as much as a hundred and eighty pounds for a horse, and is an expert rider himself. His history is romantic, and will be read with interest when it appears.

— Prof. Silvanus P. Thompson, formerly professor of experimental physics at University college, Bristol, has been made director of the Finsbury technical college of London.

— The Norwegian brig Coulant reports, that on March 21, in latitude 13° 22′ north, longitude 45° 30′ west, the ship was going nine knots under full sail, when she struck something, apparently a sandbank, and continued striking for half a minute. The vessel's speed was reduced to about five knots. The captain had no time to get a lead over, and could see nothing over the sides. At the time a heavy sea was running. It has been suggested that this might have been a submarine earthquake.

— The *Japan gazette* publishes a brief statement from Mr. Gowland, technical adviser to the Imperial mint at Osaka, on his observations during a recent journey through a part of Korea. He spent ten days at Söul, the capital, and twenty days on the overland route between that place and the port of Fasan. He did not observe any indication of mineral wealth: there were no signs of mines, and nothing beyond doubtful indications of mineral veins in one or two places. There are no mountains exceeding about four thousand feet in highest elevation, and no characteristic volcanic cones. The central range was crossed by a pass twenty-three hundred feet above the sea-level. The forests were of no great extent; but very extensive tracts of cultivated ground, evidently yielding a large surplus production of rice, barley, and beans, were noticeable throughout. There was a marked absence of any manufacturing industry, or of indications that any thing beyond food-products received attention. The traffic on the roads was very limited, — no signs of wealth, no money, and no foreign trade.

— Views of the devastation caused by the recent Spanish earthquakes still afford material for the foreign illustrated papers. The cuts here copied are taken from *La Nature* and *L'Astronomie* of recent dates; and the first one, at least, gives evidence of being drawn after a photograph, or from a careful sketch. The fracture here represented in part is described as being about a mile and a half long, and of considerable but undetermined depth. A church has sunk in it, leaving only the top of its tower above ground. The formation of the crevasses was violent, accompanied by an explosive noise; and, where they traversed villages, escape from ingulfment was by no means easy. A muleteer lost one of his mules in a fracture, and the artists of *L'Astronomie* have not hesitated to commemorate this sad occurrence by a

view that must be essentially imaginary, — a method of illustration that is unfortunately too common in works on geography.

— As the result of a series of observations made at seventeen forest meteorological stations in Prussia, Professor Müttrich has arrived at certain definite conclusions respecting the influence of the forest on temperature, which may be stated as follows: 1. The forest exercised a positive influence on the temperature of the air; 2. The daily variations of temperature were lessened by the forest, and in summer more than in winter; 3. The influence of the leafy forest was in summer greater than that of the pine-forest, while in winter the tempering influence of the pine-forest preponderated over that of the disfoliaged forest. An attempt to determine the influence of the forest on the mean annual temperature led to no sure results.

— By the present method of extracting gutta-percha, practised by the native Malayans, the tree is cut down, and the bark slit at various intervals, and, after the gum which exudes is removed, the tree is allowed to rot in the jungles. From a paper by Mr. J. L. Wray, jun., curator of the Perak museum, published in the Journal of the Straits settlements branch of the Royal Asiatic society, some startling facts are given concerning the waste resulting from this process. By actual experiment, Mr. Wray has found, first, that the wet bark which is now allowed to rot in the jungle contains fully 5.7% of its weight of gutta-percha, or, when dried, 11.4%; and secondly, that, by simply pounding and boiling the bark, nearly all this gum may be extracted. From the trunk of a tree, which he estimated to weigh 530 pounds in a wet state, he obtained but twelve ounces of gutta-percha by the ordinary Malay method, whereas, by boiling, 28 pounds more can be obtained; that is, for every pound collected, 37 pounds are wasted. It is stated that the export of gutta-percha from the Straits settlements and peninsula in 1875 reached the total weight of 10,000,000 pounds. From this it will be seen that there was no less than 300,000,000 pounds actually wasted, which represents £37,500,000 sterling. This estimate only includes the trunk, whereas the branches, and even the leaves, contain the gum. Such a wholesale waste of a material so vastly important to the world should be at once prevented if possible; and the question naturally arises, Can the bark be broken from the trees, and dealt with in the country, or can it be dried and sent to Europe to be worked over so as to be a commercial success?

THE CREVASSE NEAR GUÉVEJAR, OPENED BY THE EARTHQUAKES IN SPAIN LAST DECEMBER. (From *La Nature.*)

SCIENCE.

FRIDAY, MAY 1, 1885.

THE APRIL MEETING OF THE NATIONAL ACADEMY OF SCIENCES.

THE spring meeting of the national academy always secures a larger attendance of members than that held in the autumn, because the business of this stated session, including the election of new members, is more important. Last week, however, the attendance was not so good as usual, only thirty-seven members being registered. Of these, seventeen were from Washington, and the remainder principally from Philadelphia, Baltimore, New Haven, and Cambridge. Though lacking in special incident, the meeting was an interesting one; both scientific and business sessions extending over four days, and the papers eliciting a good share of discussion. Public and private receptions were not wanting, and the mid-day recess gave excellent opportunities for social intercourse. Though many questions affecting the policy and the development of the academy were discussed with great freedom at the business-meeting, these discussions were not marred by a single note of discord.

The trust funds of the academy having been increased during the year by the gift of eight thousand dollars from the widow of the late Professor Lawrence Smith, and in his memory, to encourage the study of meteoric bodies, Messrs. Wolcott Gibbs, Brush, Asaph Hall, Pumpelly, and Rutherford were appointed a permanent committee to administer the trust; and they were also charged with the duty of conveying to Mrs. Smith the thanks of the academy, and its appreciation of her generosity. The award of the Draper medal, made for the first time, was most appropriately bestowed on Prof. S. P. Langley of Allegheny, now absent in England, for his researches and discoveries in solar radiation.

The academy was strengthened by the election of five new members: Prof. E. S. Holden, director of Washburne observatory, Madison, Wis., the chief of the recent Caroline Island eclipse expedition; Professor Henry Mitchell of the U. S. coast-survey, whose knowledge of the hydrography of our eastern coast is unsurpassed; Mr. F. W. Putnam, the curator of the Peabody museum of American archaeology at Cambridge; Prof. W. A. Rogers of the Harvard observatory; and Mr. Arnold Hague of the U. S. geological survey, whose work has lain chiefly in our western territories. As the number of home members is now ninety-eight, it is probable that by another year it will reach a hundred, beyond which it will be difficult to pass, on account of the more stringent rules of admission which will then come into force.

We have only space to mention a portion of the papers, a complete list of which will be found in our notes. Jupiter was the subject of two astronomical papers. Prof. C. A. Young called attention to some changes in the constitution of the 'great red spot,' and to the belt of white spots in the southern hemisphere. The period of one of the latter, the upper of a lozenge-shaped series of four, he had found to be 9 h. 55 m. 12.74 s., and that of an equatorial white spot 9 h. 50 m. 9–12 s., while that of the great red spot was now 9 h. 55 m. 13.4 s. Mr. G. W. Hill discussed the two inequalities in the moon's motion due to the action of Jupiter, the theoretical discovery of which is due to Mr. Neison, finding the coefficients for these inequalities smaller than given by Neison; the former's values being $-1.163''$ and $+2.200''$, while Mr. Hill obtained $-0.903''$ and $+0.209''$. In a paper on the cause of the progressive movement of areas of low pressure, Prof. E. Loomis concluded, that, although in middle latitudes these areas usually follow the course of the winds, the general drift of atmospheric movement could not be looked upon as the cause. Their

progress could be compared to that of a great atmospheric wave, the pressure being more steady and persistent on the one side (in this case the west) than on the other. Prof. H. A. Rowland exhibited a tabular view of the different values which had been given to the ohm, and criticised that which had received the sanction of the Paris electrical conference as an average derived by giving equal weight to values obtained by admittedly unequal methods. By adding to the table of the Paris conference the results reached by the American committee in its investigations, and allowing each result its proper proportional value, he had obtained a column of mercury of one square millimetre section and 106.2 centimetres high as a satisfactory average, which the American committee therefore recommends.

Perhaps the greatest public interest attached to the two papers of Dr. Graham Bell, given on the last day of the session, one on the possibility, while at sea in a fog, of detecting by means of echoes the proximity of dangerous objects. Mr. Della Torre and Mr. Bell had experimented by means of a gun and a receiving-trumpet, and had obtained echoes from passing vessels at a distance of from a quarter of a mile to a mile, according to their size. The other showed the results of some experiments he had made on the audition of school-children of Washington. He exhibited an audiometer he had devised, in which two flat coils of insulated wire were so adjusted as to admit of separation on a graduated scale measuring the distance between their centres. An electrical current, produced by the rotation of a Siemens armature between the poles of a permanent magnet, is passed through one of the coils, and is rapidly interrupted by the rotation of a disk, a telephone being attached to the other. The intensity of the sound produced being dependent upon the intensity of the current induced in the coil to which the telephone is attached, and this upon the distance between the coils, a ready measurement of audition is obtained. The use of this instrument proved that ten per cent of the more than seven hundred pupils examined with the assistance of Mr. H. G. Rogers were hard of hearing (in their best ear), and seven per cent had very acute powers; the general range of audition being measured on the scale by the separation of the disks to a distance of from fifty to eighty centimetres, while the total range was from twenty to ninety centimetres. It is known, on the other hand, that in some institutions for the deaf as many as fifteen per cent are merely hard of hearing.

Dr. Ira Remsen brought to the notice of the academy a case in which chemical action was affected by magnetic influence. Placing a test-tube containing nitric acid in the middle of a coil through which a current was made to pass, he found that the action of the acid on a strip of iron placed in it was sensibly lessened, by at least ten per cent, when compared with that of another strip of iron placed in similar circumstances excepting for the absence of the electric current. Dr. Sterry Hunt proposed a classification of the natural silicates which make up a large part of our earth's crust, dividing them into three groups, according to their bases, and distinguishing them as protosilicates, persilicates, and protopersilicates. These divisions he believed were more natural than those which divided them according to their sensible qualities, or otherwise, and indicated genetic distinctions.

On the biological side, the papers, while perhaps not so attractive to the public as those already mentioned, were of more than usual philosophic interest. Prof. E. D. Cope, in a communication on the pretertiary vertebrates of Brazil, which were referred to the cretaceous, Jurassic, and upper paleozoic, and which contained many interesting types, pointed out also that a single pliocene fauna extended from south of our borders to Patagonia, and that neither eocene nor miocene beds had been discovered in South America. In a more elaborate paper on the phylogeny of the placental mammalia, based largely on discoveries in the western parts of North America, he claimed, that while many details remain to be worked out, and though their didelphian ancestors had

not yet been discovered, the phylogeny of the orders of placental mammals was now undoubtedly completed in its main features. The phylogeny of the clawed groups has been traced back to a common ordinal form, the Bunotheria, and that of the hoofed groups to the contemporaneous order, Côndylarthra; while at the same time the characters of the feet of the Condylarthra agree with those of clawed placental mammalia, and bind the series together; the anthropoid line may also be traced directly through the lemurs to the Condylarthra. These views were fortified by numerous examples. Mr. S. H. Scudder gave a sketch of the geological development of the orders of winged insects, in which he claimed that no ordinal differentiation could be detected in paleozoic insects, although all the existing orders were fully developed by the middle of the mesozoic period: he therefore held that we were to look to the triassic period for the most interesting future discoveries in this field. Dr. T. Gill exposed his latest views regarding the orders of fishes, and introduced a speculative paper, by Dr. Ryder, on the flukes of whales, which he looked upon as the posteriorly transferred, hypertrophied, tegumentary elements of the mammalian hind-legs, basing his argument on embryological evidence, and on the anterior transference of the front limbs and girdle in certain mammalia. Dr. J. S. Billings exhibited a series of composite photographs of skulls, and explained the method pursued in taking them directly from the skull; as also a method of measuring the cubi capacity of crania, devised by Dr. Matthews. This consisted briefly in the rapid use of water instead of shot or seed, after rendering the skull water-tight by closing all the small openings with putty, spraying the interior with thin varnish, and embedding the whole skull in putty. Finally, Major Powell read a paper on the organization of the tribe, and the differentiation of kinship, distinguishing between agnatic kinship, founded upon brother groups, and enatic kinship, founded upon sister groups.

The next meeting of the academy will be held in Albany, beginning Nov. 10.

LETTERS TO THE EDITOR.

⁎⁎ Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Mr. Hampden's designation of Sir Isaac Newton.

ON p. 283 of *Science* (April 3) it is stated that "to call Sir Isaac Newton 'a fanatical pantheist' is a happy thought which would certainly not have occurred to everybody." I trust I shall not incur the risk of identification with the disciples of Mr. John Hampden if I venture to express my conviction that this gentleman does not vituperate Newton when he applies to him a term at once appropriate and just. Surely, if such were my opinion, I should be justified in asserting that the *scholium generale* at the end of the third book of the 'Principia' reads like the drivel of a cretin rather than a scientific conclusion. While science itself forms a grand and sublime whole, — its only rival and superior being pure reason and sense,— it is nevertheless true that nothing can be more disappointing than many of the biographies of physicists, who, even in the most favorable instances, are but little great men. In Locke's correspondence with his nephew Sir Peter King, we perceive what a delicate matter it was to have any thing to do with Newton in connection with their precious mutual confidences with respect to the mystical and prophetical parts of the New Testament. Hitherto Sir Isaac's devotion — I may add, fanatical devotion — to theology has never been called in question. His laborious criticism of Dr. Burnett's 'Sacred theory of the earth' deserves a place among other kindred examples of human folly and irrational superstition, its object being to prove that the surface of the earth afforded indubitable evidences of the truth of the Bible account of creation.

M. C. O'BYRNE.

Highlands, Macon county, N.C., April 17.

A second phalanx in the third digit of a carinate-bird's wing.

There is not a single adult carinate-bird known bearing two phalanges at the third digit. Jeffries (*Proc. Bost. soc. nat. hist.*, xxi. 301-306) gives the following four families of birds having two phalanges in the first, three phalanges in the second, and one phalanx in the third digit: the Palamedeae, Anseres, Alectorides, and Pygopodes. The only living bird which has two phalanges in the third digit is the ostrich from Africa (Alix). According to Meckel (*Archiv. anat. phys.*, 1830, 233) and Nitsch (*Osteogr. beitr. naturg. vögel*, Leipzig, 1811, 90), the ostrich possesses only one phalanx in the third digit. The only known bird having four phalanges in the third digit is Archaeopteryx (Dames) from the lithographic limestone.

It is evident that all birds at a former time had four phalanges in the third digit; and it seemed very probable to me that rudiments of at least one phalanx more than in the adult ought to be found in embryos of the above four families. This probability has been verified by the examination of an embryo of Anas domestica L. (length of ulna 2.5 mm.), where I find a rudiment of a second cartilaginous phalanx in the third digit.

I think it not improbable that the rudiment of a third phalanx (if there is really a second one in the third digit) will be found in embryos of the ostrich, which I hope soon to examine.

DR. G. BAUR.

Yale-college museum, New Haven, Conn., April 24.

THE RUSSIAN BASE OF OPERATIONS AGAINST INDIA.

AT Baku, on the Caspian Sea, there stands an old temple, where for centuries a beacon has been kept continually burning by the fire-worshippers of India and Persia. The priests in the olden time declared that the light was supernatural, the gift of the god of fire. Modern science shows that the supply comes from gas-wells. On one side of this temple are derricks and oil-wells; on the other side, a great stone embankment stretching for over a mile along the seacoast, several hundred steam and sailing vessels, long trains of railroad-cars loading with oil, and a population of fifty thousand where ten years ago were less than fifteen thousand. The Parsee, tending his eternal fire, is the emblem of the past: the Russian, with his oil-wells and embankments, his railroads and steamboats, is the emblem of the present.

From Baku, steamers run north, through the Caspian Sea, to Astrakhan, near the mouth of the Volga; thence up the Volga and Kama to Perm (25 miles by rail from Ekaterinburg in Siberia, whence come the best iron rails and manufactures of iron and steel), up the Volga and the Olga to the neighborhood of Moscow, up the Volga to Rybinsk, whence a canal continues the navigation to the Baltic. On these waters the cotton from Khiva and Bokhara, the oil from the Caspian, the wool from Astrakhan, and the grain from the lower Volga, are borne to the Baltic and the North seas, while material and supplies from all parts of Europe are brought as return cargo. Some of the steamers plying on the Volga resemble our Mississippi steamers, and are as large and commodious: others, two hundred feet long, are fitted with cisterns, into which the oil flows, through pipes from reservoirs at the refineries, at the rate of from a hundred to two hundred tons an hour. Kerosene from Baku has nearly superseded the American oil in Russia, and now competes with it in Berlin and Vienna. From Baku the railroad runs west (561 miles in thirty-six hours), along the foot of the Caucasus Mountains, through Tiflis, to Poti and Batum on the Black Sea. From these seaports, Russian steamers, the best on the Mediterranean and Black seas, make quick trips to Sebastopol and Odessa; and railroads connect these cities with all parts of Russia, eastern and western Europe. Directly across from Baku (sixteen hours by steamer), on the other side of the Caspian Sea, the trans-Caspian railroad commences, runs to Askabad (280 miles), and is being rapidly extended towards Sarakhs (185 miles from the present terminus). From Sarakhs to Herat is about 200 miles up the river Hari Rud, or Tajand. The construction of a railroad would be more difficult between these places than between Sarakhs and the Caspian Sea; though, as it must follow the line of the river, there would be no obstacles that cannot be easily surmounted.

Sibi is the present terminus of the Indian railways, though the English government is extending the line 135 miles to Quetta, 470 miles from Herat by the way of Kandahar. This route crosses many rivers and mountain ranges, and will be a difficult and expensive road to build. It requires twice as long for the transit of men and supplies from Sibi to Herat as from Herat to Baku, though the distance is but little more.

The Caspian line is the most feasible and shortest route for a railroad from Europe to India.

	Hours.
From London to Berlin	24
Thence by Breslau and Lemburg to Odessa	48
By steamer to Batum	48
By rail to Baku	24
By steamer across the Caspian	16
By rail to Askabad	12
From London to Askabad [1] (7 days)	172
Thence to India, 1,000 miles, in	40
Nine days' running time, if the railroad were in operation, from London to India	212

While from London to Herat, by the Suez Canal and India, is nearly three times as long.

The trans-Caspian railroad, from the Caspian to Sarakhs, runs in a south-easterly direction, at the foot of a long range of mountains separating Turkestan from Persia. Small streams, every few miles, run down the sides of the mountains into the valley, and are soon lost in the sands of the desert. Wherever these streams appear, there are fertile oases. This desert extends from the foot of these mountains, north-east to the River Oxus, about 500 miles at the Caspian Sea, and 300 miles at

The map published in the present number, to accompany this and other articles, is based upon one issued from the office of the superintendent of the great trigonometric survey of India. The original was mapped on the bases of the surveys made by British and Russian officers up to 1881, and was published in Dehra Dun in September, 1881. As slightly reduced here, it represents the territory on a scale of an inch to forty miles. The upper broken red line represents the boundary of the territory in dispute as given on the map of which this is the copy; and it also appears in precisely the same place, in the latest reduction of the Russian staff map obtainable in St. Petersburg two years ago; but the lower broken red line indicates what is supposed to be the extreme Russian claim, and does not appear on the original from which the map is taken.

[1] Here ends the present line of railroad.

MAP TO SHOW THE RELATION OF CENTRAL ASIA AND INDIA TO EUROPE.

Sarakhs. The rivers Tajand and Murgh-áb run from the mountains of Afghan into the south-western part of the desert, nearly parallel to the Oxus, until they are absorbed by the sands of the desert. The old channels through which they once ran into the Oxus can still be traced. Formerly this desert was a rich, fertile land, cultivated by irrigation, inhabited by a vast population, where for hundreds of miles "a nightingale could fly from branch to branch of the fruit-trees, and a cat walk from wall to wall and housetop to housetop." The monuments of the old cities are frequently seen by the traveller, half buried in the sand. Now the desert is traversed only by a few wandering horsemen, or an occasional shepherd with his flocks, and is sparsely inhabited on the few oases that have been preserved.

The great cities of Turkestan are Khiva on the Oxus; Bokhara, Samarkand, and Tashkend, north of it. The former route from Russia to these cities was by rail to Orenburg on the dividing-line between Europe and Asia (and the termination of the Russian railways), thence across the desert to Kasala on the Aral Sea, then by steamer up Sir Daria (the Jaxartes) or through the Aral Sea, and up the Amu Daria (the Oxus). These rivers are navigable only at their flood, and are very dangerous even for the smallest steamers. At other seasons the route is all the way across the desert. It is 900 miles from Orenburg to Khiva, 1,100 to Bokhara, and 1,225 miles to Samarkand, and takes fifty days for the caravans to go from Orenburg to Samarkand. A few years ago this route became for a time impassable, owing to frequent incursions of robber-bands. A trader from Khiva, bound to the great fair at Nijni Novgorod, was compelled to find some other route: he crossed the desert from Khiva to the Caspian Sea (500 miles), and found it easier and quicker than from Khiva to Orenburg. Here he took the Baku steamer up the Volga to Nijni Novgorod. Other caravans followed. The Russian armies, with their supplies, which had been sent by the way of Orenburg and Kasala, were sent by the Caspian route. When the Caspian railway is extended to Sarakhs, Bokhara will be within 300 miles, and Merv less than 100 miles, from the line of the road.

The discovery of oil at Baku has built that city, and made it the *entrepot* of all kinds of stores; has opened a railroad from Tiflis to Baku, and created a fleet of steamers plying on the Caspian and Volga; has turned the course of the Asiatic trade from Orenburg to the Caspian, and transferred the government of Asia from Turkestan to Tiflis; has led to the opening of the Caspian and the construction of the trans-Caspian railroad; and has brought Merv, Herat, and India forty days nearer St. Petersburg than they were six years ago, reducing, by fully three-fourths, the cost of transportation of men and supplies, and opening a new era for Asia. The great saving in time in the cost of transportation of men, munitions of war, and stores, will amply pay the interest on the cost of the road, and its operating-expenses.

England and Russia could easily unite in the construction and operation of the Caspian road. They have a common interest, — the shortest way to their respective dominions. The cause which threatens conflict between these two powers on the borders of Afghanistan should be the occasion of peace. England wants on the west of India a strong and permanent power, such as Afghanistan can never be, although supported by constant subsidies, supplemented, when these failed, by an armed force. Russia, on her eastern boundary, also needs a strong and permanent power to restrain the wandering tribes from despoiling her territory.

The English complain that the policy of Russia for a hundred years has been to extend her dominions in every quarter, and in proof point to the continual expansion of her territory. Scarcely a century ago the eastern and southern boundaries of Russia followed the Volga down to Tsaritsin, about three hundred miles from the Caspian, then crossed to the Don, following that river to the Black Sea. Since then the Russian army has crossed the Caucasus, conquered the whole of Circassia and a portion of Persia and Turkey in Asia, and pushed its southern boundary two hundred miles south of the Caucasian Mountains. It has pushed its south-eastern boundary down to the Caspian, around the head and eastern shore of that sea, reaching out to the Sea of Aral, annexing Khiva, Bokhara, Turkestan, and the Kirghiz Steppes, even to the western boundary of China. Quite recently it has annexed Merv, and threatens Herat; and now, from the Black Sea and Persia north to the Arctic Ocean, the Russian eagle is the only flag that waves.

Russia, again and again, through her leading statesmen, has assured England that she had reached her eastern limits, and as often have these assurances been contradicted by further conquests in the east. The English naturally regard these assertions as promises made only to deceive, and to be broken as soon as the hostile feeling of Great Britain, aroused by

such conquests, has been quieted. May not, however, the intentions of the Russians be honest, and the cause of this apparent breach of faith be easily explained?

All the country from the Don and the Volga east to China and India, and from the Caucasus south to the Persian Gulf, and south-west to the Mediterranean, has been occupied on the one side by wandering tribes without fixed habitation or permanent government, marauders, slave-dealers, and vagabonds; while on the south and south-west the countries have been and are ruled by the Persians and Turks, whose dominion is a constant curse to the people over whom they rule, the tax-gatherers being the only evidence to them of a government.

Wherever the Russians have established a new eastern boundary, settlements have sprung up. These settlements must be protected from pillage by the wandering chiefs. It was not sufficient to chastise the marauders and return within the boundary, as the return was regarded as a retreat, and proof of weakness. Experience has taught the Russians, that, in order to keep peace, these tribes must be brought under Russian rule: thus, by force of circumstances, they have been compelled to extend their territory from time to time. The conquered countries have been governed by the ablest generals of Russia, a Kaufmann and a Skobeleff. Their authority was almost despotic; and frequently kingdoms have been annexed before either Russia or Europe knew of the forward movement. When once annexed, the government could not recall its army, or refrain from governing the conquered country.

The Russians are only carrying out the policy adopted by the English in India a hundred and fifty years ago. Her rule then extended only over a few tribes. Lord Clive and Warren Hastings were forced to extend her dominions north to the Himalayan Mountains, and south to the Pacific Ocean, until the whole peninsula of India became her empire; which, though not as extensive territorially as Russia, yet in wealth and population far exceeds that of Russia in Asia.

Wherever the Russian has gone, there he has carried law and government, settled habitations, and civilization. Though we may regard the civilization as crude and the government as bad, yet it is a vast improvement over the former misrule. Robbery has been stopped, slavery abolished, and the permanent cultivation of the land begun. With the exception of one or two tribes in the Caucasus, there is not a single nation or tribe that does not greatly prefer the rule of Russia to the misrule of their former chiefs.

After the capture of Merv by the Russians, Afghan was the only country that separated the Russian dominions from the English empire. The western boundary of Afghan then became a subject of great importance to England. The capture of Merv was acquiesced in by Great Britain on the agreement with Russia that a joint commission should be appointed to "delimit the Afghan frontier from Khoja Saleh on the Oxus, to Sarakhs" on the Hari-Rud, or Tajand, — a distance of about three hundred miles.

The Russians claim that this boundary-line runs south of Panj Deh, crossing the Hari-Rud or Tajand about fifty miles below Herat, following a range of mountains that runs, or at least was supposed to run, from the Oxus River to the Tajand.

The English claim that it crosses the river about two hundred miles below Herat. The line has never been fixed. In the article on Afghanistan, in the last edition of the *Encyclopaedia Britannica*, two boundaries are given. The first crosses the river about seventy miles below Herat, and follows closely the line now claimed by Russia. It says, "The half-independent Hazara tribes stretch across the branches of the river of Herat, and down into the Oxus basin, so that it is difficult here to assign a boundary."

On two maps in my French atlas, the boundary-line crosses the Tajand at different places. On the large map of the Messrs. Johnson, published in Edinburgh, two boundaries are also given; though the outer one, now claimed by England, has greater prominence. At one time the line was described as running along a high mountain range which passed south of the Murgh-áb River, and between that river and the Tajand, — substantially the line now claimed by Russia; but when it was discovered that this range existed only on the maps and in accounts of early travellers, and that there was no mountain barrier, the boundary-line was moved farther west.[1] Until recently, the western boundary had never been a subject of interest to the amir of Afghan or to the English or Russian governments. The land within the disputed territory is of little value. The population is sparse, with few affiliations with the Afghans. The people belong to a different race, having features of the Mongol type, speaking a different language, and pay-

[1] The London *Times* says, "The limits have changed according to the character and military resources of the chiefs ruling at Herat, Kabul, and Kandahar."

ing tribute to the Afghans only when compelled by an armed force. According to the London *Times*, the amir of Afghan did not occupy this disputed territory until 1883, when he received a map from the viceroy of India, with the boundary-line now claimed.

The Russians claim that the English have furnished the Afghans with maps, plans of fortifications, money to build and equip these forts, and engineers to superintend the construction, and that these acts are a breach of good faith on the part of England. The English claim that Russia has sent an armed force into the disputed territory, occupying at least two towns, and that these acts are a breach of good faith on the part of Russia.

The English policy in India has been the same as that of Russia. It was found necessary, and proved successful, to the maintenance of order; and there is every reason to believe that a similar policy will produce like results.

Gardiner G. Hubbard.

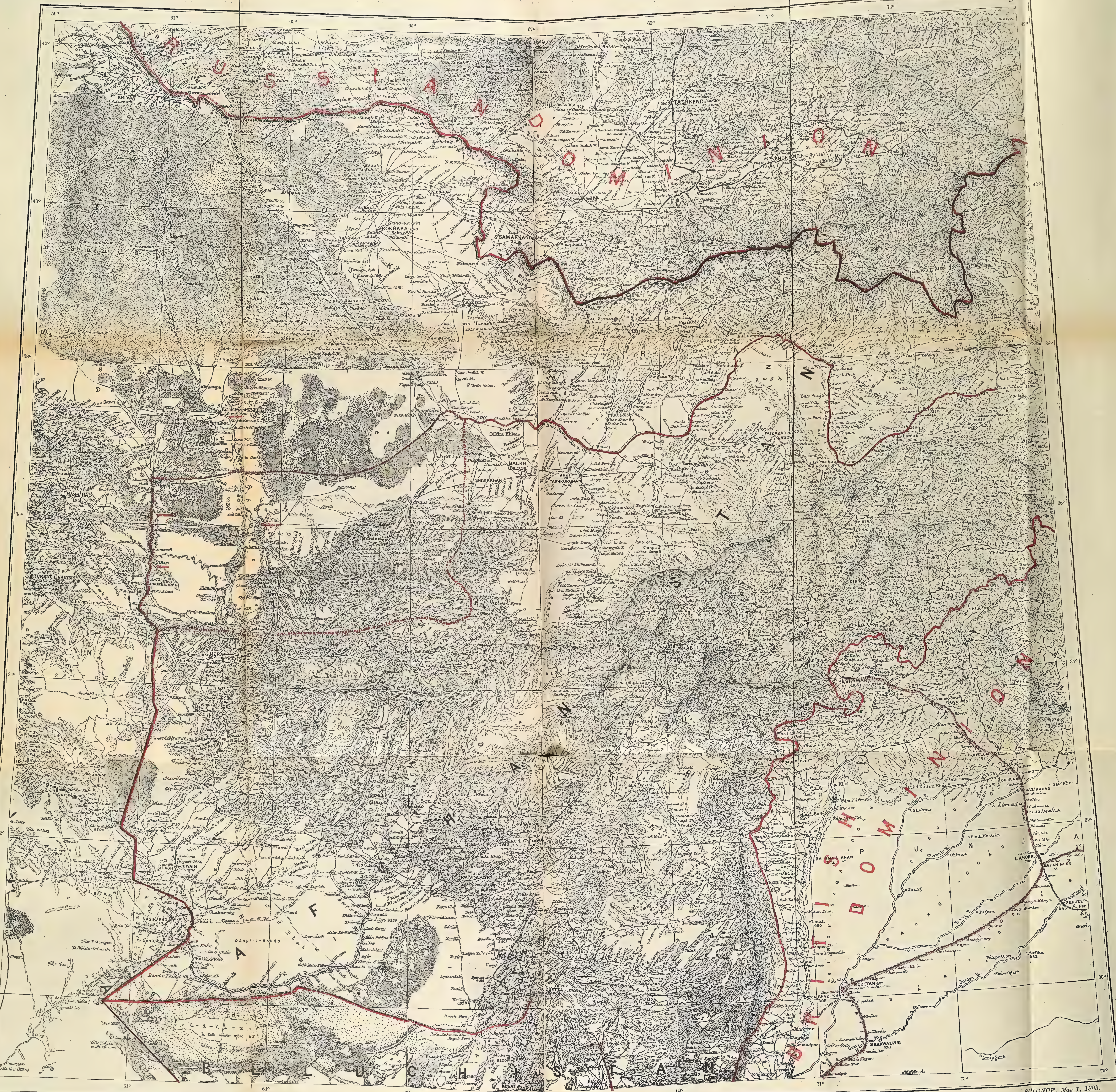
ROADS FROM INDIA TO CENTRAL ASIA.

Dost Muhammad, one of the most famous amirs of Afghanistan, is reported to have said that he could not understand why the masters of the riches of India ever should have designed "occupying such a country as Kabul, where there is nothing but rocks and stones." It was a shrewd remark; and Afghanistan owes its importance, not to the fertility of its soil or to any other natural advantages, but to the fact that the great trade and military routes of central Asia lie within its borders. Afghanistan — using the word in its broadest sense, as including all the territory under the rule of the present amir — takes the form, roughly speaking, of an immense square, with sides of about six hundred miles in length. On the west a well-defined boundary separates it from Persia. To the south the dividing-line between the territories of the amir and those of the khan of Kelat, as the ruler of Baluchistan is often called in English books, is not so well marked; but, as a large portion of it runs through an uninhabitable salt desert, this is not of much importance. On the east the Suliman and other mountain ranges form a natural frontier between Afghanistan and British India. At one time this mountain barrier was supposed to be impracticable for the movement of large masses of troops. To-day it is certain that such is not the case; for, in addition to the well-known Khyber, Kuram, and Bolan passes, more than two hundred other paths cross these mountains in every direction. In fact, the barrier is no barrier at all, and would offer but little resistance to an enterprising general. It is on the north, however, that Afghanistan is most vulnerable. True, the Amu Daria or Oxus River, from its source 13,900 feet above the sea, in Lake Sir-i-Kuld, in the highland of Great Pamir, to Khoja Saleh, separates the Afghan provinces of Badakshan and Turkestan from the Russian dominions of Ferghana and Bokhara. But a river is, at best, a poor boundary, from a military point of view; and, besides, from Khoja Saleh to the Persian frontier, on the Hari-Rud, the line, wherever run, must be purely artificial.

More unfortunate still, the Hindu Kush, with its outlying spurs — the Khor-i-Baba, Safed Kur (White Mountains), and Siah Kur (Black Mountains) — running from east to west, divides Afghanistan into two unequal parts. The territory lying north of these mountains belongs, physically speaking, to the basin of the Oxus (Aralo-Caspian basin), or, in other words, to Russian Asia. In addition, these mountains, together with their off-shoots to the south, prevent, during five months in each year, all direct communication between Kabul, the chief city of the east, and Herat, the equally important emporium of the west. The main route between these two places is through Kandahar, which thus lies at the southern apex of a nearly equilateral triangle, with sides of three hundred and three hundred and thirty-five miles. The position of these places once thoroughly grasped, there is no difficulty in understanding the base of the English operations in Afghanistan.

From Karachi (Kurrachee) on the Arabian Gulf, and near the mouth of the river Indus, a railway runs along that river by Haidarabad to Sukkur. At this point it crosses the Indus, and, passing by Multan, joins the line from Calcutta and Bombay at Lahore. The latter road runs thence by Rawal Pindi, crossing the Indus near Attock, to Peshawar at the entrance of the Khyber Pass. The last of this railway-system — 'the missing link from Multan to Lahore' — was open to traffic in 1878.

Kabul, the chief political city of Afghanistan, contains a population of between fifty and sixty thousand. It is situated on the Kabul River, not far from its confluence with the Logar, and is the converging point of the trade-routes from Afghan Turkestan, and the countries beyond the Oxus, over the difficult mountain passes, eleven and twelve thousand feet high, of the Hindu Kush; from Persia and Baluchistan by Kandahar; and from India by



Reproduced from map issued by the Great trigonometric survey of India.

SCIENCE, May 1, 1885.

MAP OF CENTRAL ASIA ON THE BASIS OF THE SURVEYS MADE BY BRITISH AND RUSSIAN OFFICERS UP TO 1881.

the Khyber and Kuram passes. From Kabul to Peshawar (190 miles), the road leads by the Khurd Kabul or Lutaband passes to the Jagdalak Pass. It was in these narrow defiles that the English army was slaughtered by the Afghans in 1842. Thence by Gandamak and Jalalabad, on the Kabul River, the road runs to Lalpura. There it leaves the river, and follows two mountain streams over the Khyber Pass (3,000 feet), to Peshawar. This route was followed by Elphinstone and Pollock in the first Afghan war; and, now that the terminus of the Punjab railway is at Peshawar, it is the most important route from India to eastern Afghanistan, although Gen. (now Sir Frederick) Roberts, in 1879, led his army over the more southern Kuram Pass to Kabul.

Kandahar, the great trade-centre of the south, lying on the direct road from India to Herat, is likely to be of more importance in case of a war between England and Russia. It is situated in a small plain between the Arghand-áb and Tarnak rivers, and commands the road through the Tarnak valley, by Ghazni, to Kabul (318 miles). Sir John Keane took this route on his march to Kandahar in 1838; Nott marched by it in 1842, to aid Pollock in avenging the massacre of Elphinstone's expedition; and it was by this road that Sir Frederick Roberts made his famous march from Kabul to the relief of Kandahar in 1880. The railroad from India to Kandahar leaves the main line from Karachi to Lahore, at Sukkur on the Indus; thence by Shikarpur and Sibi to Rindli, at the entrance of the Bolan Pass. Here the railway stops; but a good carriage-road has been constructed, at least as far as Quetta. Unfortunately no bridges were built over the streams, they being crossed by fords; and this has made it impossible to lay a light military railway along the road. Indeed, it has been stated that a thoroughly built railway could not be opened to Quetta in less than two years. Quetta, or Shal, is situated between the head of the Bolan Pass and the Pishin valley. It commands the road, and is therefore a place of very great military importance. The Bolan Pass and Quetta are in Baluchistan; but the English acquired by treaty, in 1876, the right to hold and use the pass and town for military purposes, and Quetta is now the most advanced English outpost. The road leads thence through the Pishin valley, and over the Kojak or Gwaja passes to Kandahar. From the end of the railway at Rindli, to Kandahar, is somewhere between 200 and 260 miles. Authority has been given to complete it to the Pishin valley within a hundred miles of Kandahar. That city was occupied by the English from 1839 to 1842, and again from 1879 to 1881. The trade-route thence to Herat, nearly 370 miles away, leads by two strong positions, — Kushk-i-Nakud, the scene of Burrows's defeat in 1880, and Girishk, — and over several mountain passes. But the importance of this road, and of Kandahar itself, has been lessened by the discovery of a much longer, but nevertheless good, route from Quetta to Herat without passing Kandahar. It was by this road that Gen. Lumsden's Indian escort, over 1,300 strong, and with a train of 1,300 camels and 400 mules, marched at an average rate of eighteen miles a day to meet him on the frontier.

Herat (Heri) is situated on a fertile plain, near the river Hari-Rud (river of Heri or Herat), between the western extremities of the spurs of the Hindu Kush, above mentioned. Its importance, both commercial and strategic, is due to the fact that it dominates the best road from the Caspian by Mash-had, to the Indus by Kandahar. The position of the city itself, from a military point of view, is not good; because its defences are, as Gen. Grodekoff pointed out, commanded by a neighboring hill.

The Hari-Rud rises in the heart of Afghanistan, and flowing almost due west along the northern base of the Paropamisus Hills, within a few miles of Herat, strikes the Persian frontier seventy miles beyond that city, at Kusan. There it abruptly turns north, and, passing Zolfikar, — a name given to a ford, but more correctly, perhaps, to a neighboring pass in the hills, — reaches Pul-i-Khatun. At this point it receives its principal affluent, the Kashaf Rud, from the west. The Kashaf and Hari-Rud, after leaving Pul-i-Khatun, take the name of Tajand, and, passing Sarakhs, become desiccated in the Turkoman Steppe. The oasis thus formed lies between Merv and Persia, and for this reason has been nearly uninhabited until the recent Russian advance upon Merv.

The river Murgh-ab rises to the south of the Paropamisus Hills, and, flowing in a general northerly direction, passes the Afghan stronghold of Bala Murghab, on the road from Herat to Maimana and Afghan Turkestan; thence it flows by Meruchak (where, according to the Russians, the north-western boundary of Afghanistan crosses the river), by Panj Deh and Yulatan, to Merv, where it loses itself in the irrigation canals of that oasis.

A few miles below Panj Deh the Murgh-áb receives from the west the river Kushk, which rises to the north of the water-parting not far

from Herat. The road from Herat to Bala Murghab crosses its upper waters. At some point near the confluence of the Murgh-áb and the Kushk the Afghans constructed a small fort called Ak Tepe. The Merv oasis, from just above Yulatan, stretches along the Murgh-áb for nearly sixty miles. Its width is not far from forty miles, and it may be said to be only 240 miles from Herat. A detailed and interesting description of the oasis, together with a clear plan, is given in the second volume of O'Donovan's 'Merv Oasis.' It is only necessary to say here that Merv is the converging point of the caravan routes from Persia by Mash-had, to Khiva, at the northern end of the Turkoman Steppe, and to Bokhara and the countries beyond the Oxus.

Edward Channing.

THE RACES OF CENTRAL ASIA.

Afghanistan is inhabited by many different tribes and races, of whom the Afghans are undoubtedly the dominant race; but the extent of their dominion at any one time depends more upon the skill and energy of the Afghan chief or amir for the time being, than it does upon any prescriptive right or tradition. Indeed, there are living at the present moment, in the mountainous districts, non-Afghan tribes which have never been subdued. And the Hazara dwelling on the great central plateau are only tributary to the ruler of Kabul when that potentate is sufficiently strong at home to spare soldiers to collect the tribute or taxes. There is no settled government in the country. The amir's authority is respected only when he possesses means of compelling respect. Each tribe and clan manages its own immediate affairs through a council of the elders, and in accordance with the immemorial customs of the tribe. The amir is merely a dictator for life; and every attempt, in recent times, to introduce a settled form of government or to establish a dynasty, has been an immediate and complete failure. It is this want of cohesion among the Afghans themselves that has brought about the interference of the English in their domestic and foreign relations. The true Afghan tribes live in the valleys between Kabul and Peshawar, and Kabul and Kandahar. They are a sturdy, daring people, and are described as possessing a strong Jewish cast of countenance. This latter peculiarity has induced some learned and enthusiastic ethnologists to declare that they, like all other races whose origin is unknown, are the descendants of the ten lost tribes of Israel. However this may be, they at one time extended their rule to the south of Peshawar, and have been a constant thorn in the flesh of the viceroy of India from the beginning of the century to the present day.

To show the fluctuating nature of the Afghan dominion, let us briefly trace the history of the country from 1842 to the present year. In 1842 the English abandoned the attempt to force a ruler on the Afghans, and again recognized Dost Muhammad as amir of Kabul. Eight years later, that chieftain reconquered Balkh, then the most important town north of the Hindu Kush; and between 1850 and 1860 he extended his rule over the whole of Afghan Turkestan, and reduced Badakshan to the condition of a tributary province. In 1855 he took Kandahar, and thus established his authority in the south. But it was not until 1863 that he captured Herat. Then, for the first time since the days of Timur, there was one supreme ruler in the country. Two weeks later he died. His son, Shir Ali, succeeded him. But there were many rivals in the field, among them Abdurrahman Khan, the present amir; and Shir Ali cannot be said to have been the undisputed ruler of Afghanistan before 1868. His attention was then directed to persuading the English, in return for valuable concessions, to guarantee the amirship to himself and his descendants, and also to supply him with funds with which to raise and maintain an army in the face of the unpopularity his reforms were arousing in Afghanistan. In this he was only partially successful; and in 1878 he turned to the Russians. Gen. Stolietoff was received at Kabul as ambassador, and Gen. Grodekoff was escorted through Afghan Turkestan to Herat, while the English envoy was not even allowed to cross the frontier. War followed; and in a few months Shir Ali died a fugitive at Mazar-i-Sharif. His second son, Yakub Khan, was recognized by the English as amir; and, upon his signing the treaty of Gandamak in 1879, the English evacuated the country. By this treaty the foreign relations of Afghanistan were placed under the control of the English, who were to be allowed to send a 'resident' to Kabul. Shortly after his arrival, Major Cavagnari, the 'resident,' was murdered. The English again invaded the country, deposed Yakub Khan, and recognized his cousin, Abdurrahman Khan, for many years an exile in Bokhara and Samarkand, as amir. Kabul was evacuated in 1880, and Kandahar in 1881. In 1883 the new amir drove Ayub Khan, another son of Shir Ali,

out of Herat, and became sole ruler of Afghanistan.

North of the Hindu Kush, and between that range, the Oxus River, and the Turkoman Steppe, are situated Badakshan and Afghan Turkestan, as the provinces of Kunduz, Khulm, Balkh, Sir-i-pul, Shibirkhan, Andkhui, and Maimana are conveniently called nowadays. The great mass of the population belongs to the Usbeg race, who are of the same Turki stock as the Usbeg inhabitants of Russian Turkestan. The best account of this part of the world, in recent times, is 'Gen. Grodekoff's ride from Samarkand to Herat,' translated from the Russian by the indefatigable Charles Marvin.

Before 1872, Balkh, near the ruins of the ancient Bactra, was the capital of Afghan Turkestan. But in that year the cholera raged there with such virulence that the seat of government was removed to Mazar-i-Sharif, a few miles to the east, where is situated, according to the Usbegs, the tomb of Ali. Balkh is now an insignificant village. Gen. Grodekoff spent a couple of weeks of enforced idleness at Mazar-i-Sharif in 1878; and to his Russian eyes the Usbegs seemed ready to fall into the arms of the czar, the advance of whose armies, however menacing to Afghanistan and India, has certainly brought order and law to central Asia, and especially to the Usbeg countries of Bokhara and Khiva. Almost nothing is known of the condition of the country at the present time; but the Usbegs assisted Abdurrahman Khan in his struggle against the sons of Shir Ali. That they are more trusted by the Kabulites now than in 1878, is shown by the fact, that, while they were then disarmed, an Usbeg corps formed part of the amir's escort to the recent conference at Rawal Pindi.

The origin of the Turkomans is veiled in obscurity; but it may be stated as certain, that in 1830 the Tekke Turkomans occupied the Akhal oasis, the Sarik Turkomans lived amidst the ruins of Merv, and the Salor Turkomans resided in and around Sarakhs. They were all robbers and slave-stealers, but the Tekkes seem to have been by far the most savage and energetic. They flourished, and outgrew the capabilities of the Akhal oasis. A portion split off, and, advancing to the east, settled down on the Tajand. The Persians, in 1833, fell upon the Salors at Sarakhs, and all that escaped took refuge among the Sariks at Merv. The Tekkes then moved on to Sarakhs, and, as they gradually acquired strength, extended their forays to Khiva, Bokhara, and to every part of Persian Khorassan. This brought upon them the vengeance of the Persians, who, in 1857, drove them from Sarakhs to Merv. As there was not room on that oasis for such a large population, the Tekkes compelled the Sariks to move farther up the Murgháb. They established themselves at Yulatan and Panj Deh, driving out the Salors, and according to the Russian general, Petrusevitch, some Afghan nomads who fed their flocks near the latter place. The Tekkes, now masters of Merv, built an enormous dam at Benti, and by means of lateral canals greatly increased the cultivable area of the oasis, until it became capable of supporting a population of not less than a quarter-million souls. From this secure retreat, the Merv Tekkes raided the frontier provinces of Persia and Afghanistan, until whole districts became desolate. In 1861 a Persian army thirty thousand strong, accompanied by artillery, was sent against them; but instead of defeating the Merv Tekkes, the Persians were overthrown, and fully one-half captured and sold into slavery by the Mervli. After the Russians had brought Khiva and Bokhara under their dominion in 1873, they abolished slavery in those places, and, by closing their great slave-markets, took away from the Tekkes the incentive to the capture of slaves.

The ground put forward by Russia to justify her occupation of Panj Deh and Sarakhs is now clear; that is, if we allow that the Sariks were tributary to the Merv Tekkes. Those of Yulatan undoubtedly were; they could not very well help it, living as they did on the oasis. But the case is not so clear as to the Panj Deh Sariks, who, according to the English and Afghans, pay tribute to Herat. The Russians reply that no tribute is paid except at the point of the bayonet, and therefore, on ethnological grounds, Panj Deh should go with Merv. That compulsion is necessary, is certainly true. It is admitted by the Afghans. But the soldier is the tax-gatherer not only of Panj Deh, but of central Asia. In conclusion, it will not be amiss to again point out that all of Afghanistan north of the Hindu Kush and its outlying spurs belongs, both geographically and ethnographically, to Russian Asia, rather than to Afghanistan. EDWARD CHANNING.

THE LEGAL LANGUAGE OF INDIA.[1]

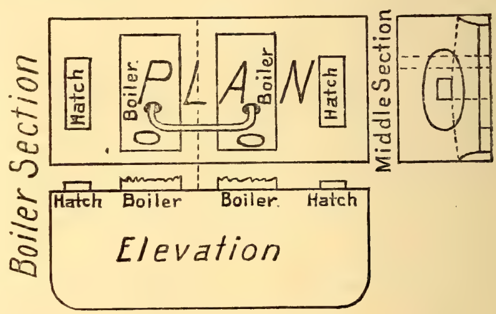
In the higher courts of justice and in government administration in Calcutta, Madras, and Bombay, the English language is coming into general use. In

[1] Translated from the *Oesterreichische monatsschrift für den orient.*

the courts, both written and spoken proceedings are in English. In the examination of native witnesses, and in the reading of documents in the native language, the judges are allowed interpreters. In other parts of India, however, the provincial language is used, both in legal and in government transactions: thus, in Bengal, the Bengalese is employed; in Behar and the north-western provinces, the Urdu and Hindu dialects; in Madras, the Telugu and Tamil; the official language varying in accordance with the dialect used in each province. In law cases the magistrates have the privilege of declaring which dialect is to be considered legal. English-speaking officers (either Englishmen or natives) can use English in rendering their judgments, etc.; but they must be perfectly familiar with the native tongue, and use it in intercourse with the parties. Everywhere in the cantons, schools are organized in which elementary instruction in the provincial dialects is given: in all the more important places there are schools in which English is taught; and there are a smaller number of colleges in which those higher branches, usually taught in English high schools and colleges, may be studied. Besides these, there are a considerable number of colleges especially devoted to the study of eastern dialects. In this class are the midrassi (Mohammedan theological high schools, in which philosophy and science also are taught), and Sanskrit colleges and schools, a considerable number of which are at present encouraged and supported by the government. The use of the native dialects has always been encouraged by the English government; and in reference to this there has never been any agitation among the native population. But there are numerous associations with the declared purpose of protecting the interests of the natives; and thus it happens that the wishes of government which are in accord with the existence and spread of education among the natives, are at times supported by these associations. Petitions and presentations may be drawn up either in the official dialect of the province or in English. In reality, documents of this kind always receive consideration, whatever language is used.

HAULING A STEAMER THROUGH AFRICA.

FROM letters of one of the agents of the International African association, we gather the following account of the transportation of the steamer Le Stanley along the banks of the Kongo from the Atlantic to Stanley Pool. As the rapids in the river necessitated the hauling of this craft over the land, she was divided into nine sections, about eight feet by sixteen, each of which was mounted on a heavy iron wagon, especially designed for the purpose, which required, through the roadless country on level ground, some eighty Zanzibaris each to haul them. It will readily be understood that in such a hilly country considerable difficulty was to be met in managing these wagons; and the transportation has not been effected without many accidents. As many as twenty per cent of the men were generally incapacitated for work by broken limbs, or wounds, though only two were actually killed. This is a very small proportion, when the dangers are considered to which these fellows were exposed, which can be best imagined when one thinks of a wagon of iron, loaded with several tons of the same metal, running down a steep hill, almost or entirely beyond the control of its attendants. This down-hill movement was only attempted with some fifty men in front, and two hundred behind, exerting all their strength to check the speed. The negroes would always stand by the wagon as long as a white man did; but the minute their white superintendent or commander had let go, they followed his example with alacrity. The wagons were steered by three of the Zanzibaris, who, strange to say, always escaped, very possibly owing to their superior agility. On one of the down-hill movements, when a wagon got entirely beyond control, the wheels were broken off, and one was found sticking in the mud, but another was never seen again.



The steamer, which by this time is probably finished, is a clumsy affair, of great beam and light draught, about sixty-nine feet long. A clear idea may be obtained of the form of the vessel from the accompanying plans of the section containing the two boilers. When finished, the steamer will be eighty feet six inches long, including the wheel, which is at the stern; and about the same beam throughout, excepting at the bow, which is of course tapering. The boilers are placed at the bow; and the machinery at the stern, acting directly on the paddle-wheel, eight feet four inches in diameter. Le Stanley is not a beautiful boat, but will serve a good purpose on the Kongo, where there were only a few steam-launches before her completion. Her capacity is large, and, when loaded, she draws only two feet of water.

THE EFFICIENCY OF THE STEAM-ENGINE.

THE results of a series of trials of steam-engines, tested without reference to the efficiency of the boiler, by Mr. J. G. Mair, and reported by him to the British institution of civil engineers,[1] will repay careful study

[1] Excerpts, lxxix. part i.

and unusually detailed discussion. Mr. Mair has been one of the earliest and most earnest advocates of this system of 'independent engine-tests,' and has followed closely upon the steps of Messrs. Farey & Donkin, and of Sir Frederick Bramwell, in carrying out this undoubtedly correct method.

By this system, the power of the engine, and the distribution and variations of weight of steam in the steam-cylinder, are determined by the indicator in the usual way; while, at the same time, the discharge of heat into the condenser of the engine is measured by introducing a weir at the discharge from the hot-well, and, by the use of properly disposed thermometers, calculating from the readings so obtained the number of thermal units of heat-energy thus carried away from the engine. The sum of the quantities of heat carried off, the heat converted into power and utilized as mechanical energy, and the heat wasted in various ways in its passage through the machine, should evidently be equal to the heat received from the boiler. The latter quantity is usually capable of easy determination; and the power of the engine as shown by the indicator, and the losses in the condensing water, are the other important quantities, and these are also readily ascertainable. The comparison thus made is that of the heat produced at the generator, with the power derived from it; and, this comparison being effected, it becomes easy to calculate, from the data thus obtained, what is the actual efficiency of the engine; what are the wastes, and in what direction they occur; and, finally, in what direction improvement may be looked for, and to what extent it is possible.

Mr. Mair's trials were made with several engines, and in some cases with the same engine under varying conditions. Of the engines tested, one was a single-cylinder beam-engine, one was a 'Bull-Cornish engine,' and the others were Woolf arrangements of the compound engine. With the first of these engines, steam was carried at from 56 to 59 pounds' pressure, measured from vacuum. The speed of piston was from 222 to 240 feet per minute, and the ratio of expansion varied from 2 to 4.33. The steam used was practically dry, containing, by observation, but one per cent of water. The amount passing through the jacket was from 4.4% to 4.9%, except on one occasion, when the jacket-steam was entirely shut off. The power of the engine was from 120 to 125 horse-power, as shown by indicator.

The proportion of water condensed in the cylinder, up to the point of cut-off, varied from 15% to 30%, as the ratio of expansion increased from 2 to 4.33, and was brought up to 37% at the ratio 3.84 by shutting off the jacket. The heat supplied to the engine, measured in British thermal units, varied from 416 to 516 per horse-power per minute; the best work being done, and most economy exhibited, at a ratio of expansion of 3.16. When the jacket-steam was shut off, the consumption of heat amounted to 516 units per minute. The consumption of steam amounted to from 21 to 26.5 pounds per horse-power per hour. The theoretical efficiency was from 25% to 27%, while the actual efficiency was from 8% to 10%, or from 33% to 37% of that estimated on the assumption of perfect freedom from wastes other than the necessary thermodynamic waste of the perfect engine.

Comparing these figures, it will be seen that the cylinder waste amounts, in this engine, to about ten or twelve hundredths the ratio of expansion, in percentage of the total heat or steam supplied in the cases of trial of the jacketed cylinder. Throwing off the jackets brings up the waste to a percentage equal to nearly fifteen-hundredths the ratio of expansion.

The 'Bull-Cornish engine' is a pumping-engine in which the steam-distribution is effected as in the ordinary Cornish engine; but the beam is dispensed with, and the cylinder is inverted and set directly over the shaft and pump-rod. It is thus impossible to use safely as large a ratio of expansion as in the common form of Cornish engine, the distribution of weights being less capable of a wide range of adjustment. In this case, the engine was worked with 55 pounds' absolute steam-pressure, at a piston-speed of 244 feet per minute, using dry steam at a ratio of expansion of 1.75. In this case, the amount of condensation at cut-off was 17%; the power was 175 horse-power; the heat used was about 624 thermal units per minute, and the steam 32 pounds per horse-power per hour; the theoretical efficiency was 23%, the actual 7%, and the latter was 30% of the former. The 'Bull-Cornish engine' is thus seen to be substantially equal to the single-cylinder, jacketed beam-engine in waste by condensation, but, on the whole, to be inferior to the latter in its consumption of heat and of steam under substantially equivalent conditions.

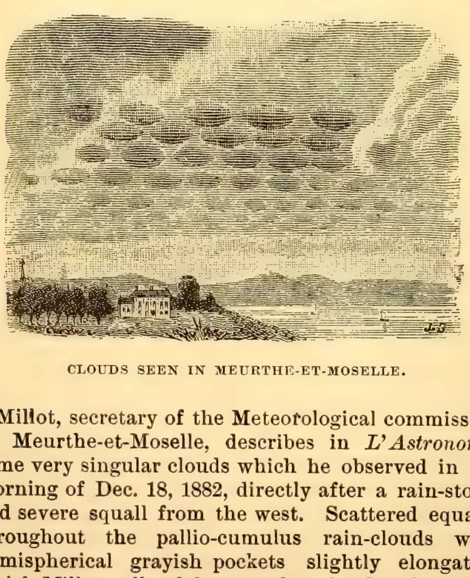
The Woolf compound engines were worked with steam varying from 67 to 78 pounds' pressure, absolute, with piston-speeds from 284 to 368 feet per minute, and at ratios of expansion varying between 10 and 16.5. Their power ranged from 133 to 215 horse-power, and the amount of heat supplied ranged from 296 to 324 thermal units per horse-power per hour. The cylinder-condensation ranged from 24% to 31%, or about eight times the square root of the ratio of expansion, in per cent, of steam supplied. The engines used from 15.12 to 16.6 pounds per horse-power and per hour. The efficiencies, theoretical and actual, were from 25% to 30%, and from 13% to 14%; the latter quantity being nearly one-half the former. The consumption of steam, on these trials, is extraordinarily low, — the lowest on record, probably, — and should be checked by repeated experiment.

On the whole, these reports present the class of data that the engineer greatly needs, both for the purpose of determining the direction and the limitations of further improvement of the steam-engine, and for the purpose of securing a more practically applicable theory of the real, as distinguished from the ideal heat-engine. R. H. Thurston.

METEOROLOGICAL NOTES.

The Russian meteorologist, Woeikof, known in this country from his share in the final preparation

of Coffin's great work on the winds of the globe, is one of the most industrious, as well as one of the best, writers among the modern meteorologists. He has lately published a good-sized volume on climatology, in Russian, from which a sample chapter on the influence of forests is translated in a recent number of *Petermann's mittheilungen*, to which we shall shortly refer. Besides this, the German and Austrian journals of meteorology contain frequent contributions from his study devoted largely to the discussion of the climate of the eastern dominions of Russia. Among these, that on the climate of East Siberia contains many facts of interest, especially in relation to the extremes of winter cold observed at Yakutsk and other low inland stations, where the average January temperature is close about the freezing-point of mercury. It is found that the excessive cold that characterizes the long, clear, quiet winter nights of that region is most severe in the low valleys, while the elevated stations have a distinctly milder winter, although still surely cold enough; so that at this season the air is generally warmer at a moderate altitude above the earth than at its surface. This inversion from the normal decrease of temperature vertically, had already been inferred by Hann to be a characteristic of the cold season of continental interiors, but its best observational proof is now given by Woeikof. It results directly from the ease with which the land cools by excessive radiation in winter, while the air which is slower to lose its warmth departs less from its average annual temperature. An example of a similar condition in this country is given in an account of the cold island in Michigan, by Alexander, in a late number of the *American meteorological journal.*



CLOUDS SEEN IN MEURTHE-ET-MOSELLE.

Millot, secretary of the Meteorological commission of Meurthe-et-Moselle, describes in *L'Astronomie* some very singular clouds which he observed in the morning of Dec. 18, 1882, directly after a rain-storm and severe squall from the west. Scattered equally throughout the pallio-cumulus rain-clouds were hemispherical grayish pockets slightly elongated, which Millot calls globo-cumulus clouds. They are represented in the accompanying cut.

Elfert, in his paper on cloudiness in central Europe, presents statistics of cloudiness from three hundred and nineteen stations scattered generally throughout western Europe between latitudes 39° and 60°, and longitudes 4° and 30°. The stations range in height from near sea-level up to nearly nine thousand feet above. The periods of observation vary from one year to forty or more, and few stations have been occupied for a less period than three years. Statistics of the monthly, seasonal, and annual percentages of cloudiness are given for all these stations, showing a mean percentage of cloudiness in central Europe, in winter, of 69; in spring, of 59; in summer, of 55; and in autumn, of 64. The mean of the year is 62%. Over the greater part of the area under discussion, the maximum of cloudiness is reached in winter, and the minimum in summer; but in the alpine region these conditions are reversed, while in the low region of Holland and Belgium the maximum is in spring, and the minimum in the autumn. The distribution of the annual cloudiness shows little appearance of design, further than the general fact that cloudiness is more general in the northern than in the southern part of the area. The general tables are succeeded by discussions concerning the relations of relative humidity and of the direction of the wind to degree of cloudiness, and of the relative proportions of cloudiness at different times of the day. The paper is illustrated by maps and diagrams.

THE RUSSIAN EMBASSY TO AFGHANISTAN.

THE origin and growth of the present Russian empire are intimately connected with the courses of the great rivers of Russia. Between the White Sea and the Pontus Euxinus, the Baltic and the Caspian seas, the country, totally devoid of dominating elevations, bears the character of an extensive lowland, stretching towards the south. Orographically it may be considered as the continuation of the plains of central Asia, with which it is connected. Over this tract of land various Slavonic tribes, the present Russians, have been spreading at a more or less rapid rate, especially in a south-eastern direction. Subjugating those who offered resistance, they ever remembered the words, 'to conquer, or to perish,' — the proud device of Swätosloff, their first great leader. Unlike the bloodthirsty Asiatic warriors, themselves an agricultural people, they were the bearers of civilization, whether they moved toward the north, east, or south. In some directions their progress necessarily had to be slow; but it has steadily been going on for the past two thousand years.

Reise der russischen gesandtschaft in Afghanistan und Buchara in den jahren 1878–79, von DR. J. L. JAWORSKIJ. *Aus dem russischen übersetzt und mit einem vorwort und anmerkungen versehen*, von DR. ED. PETRI, docent für geographie und anthropologie an der Universität Bern. Bd. i. Jena, *Costenoble*, 1885. 12+427 p., illustr. 8°.

It is not difficult to comprehend the motives by which, in 1869, Russia was prompted to send her troops across the Caspian Sea; and it is likewise easy to perceive why, nine years later, she sent an embassy to Afghanistan, whose voyage is partly described in the volume now before us. The person intrusted with this mission was Major-Gen. N. G. Stolettoff of the imperial army. His command consisted of twenty-two Cossacks, a colonel, a topographer, three interpreters, and a physician. The latter, Dr. Jaworskij, who also performed the duty of historian, some time ago published two short volumes in Russian, containing the results of his observations. The first volume of this work has just been issued in a German translation.

Similar to other previous travellers, who have been visitors rather than explorers, the members of the embassy followed a single track, the shortest from one important point to the next, leaving the country to right and left unvisited. At the time the voyage was undertaken, the existing maps of the country had been mostly compiled from rough and unscientific observations. They were necessarily incomplete: places were located miles from their true position, rivers were running up hills, and mountains were set upon plains. Unlike most of his predecessors, Dr. Jaworskij, evidently accustomed to observing, had eyes to see, and ears to hear; and his descriptive power is certainly not of an inferior order. As a physician, he had rare opportunities to observe the family life of the various tribes through whose dominions the track of the embassy passed, and to study habits and customs which would probably escape the notice of the ordinary traveller. We watch him with true pleasure, making his preparations at Tashkend, the place from which the embassy started. We follow him to Samarkand, and thence to Dsham. We get acquainted with the genuine hospitality of the Bokharians, with the mode of life of the members of the embassy while at Karshi, and the ceremonies accompanying the receptions given by the emir of Bokhara. Leaving Karshi, the travellers wended their way across the steppe, to Amu Daria. While attempting to cross the river bearing the same name, they met with serious difficulties, as the Afghans would not permit them to land on their native soil. This obstacle, however, was soon overcome: they were made at home by the officials of Amu Daria, and received a military escort of three hundred men to take them across the desert to Mazár-i-Sharif, where they were welcomed by the serdar, at the head of several regiments of soldiers. Notwithstanding all the precautions taken, most of the Russians suffered severely from the local malarial fever, which induced them to leave their quarters sooner than their suspicious hosts had originally anticipated. Accepting an invitation, tendered them by the emir Shir-Ali-Khan, to come to Kabul, they set out for that place after a fortnight's sojourn. Kabul was to be the terminus of their voyage.

Passing the valley of the Amu Daria, of which the author gives a graphic description, which may be considered a brief monograph, the travellers followed the banks of the Khulm. They then moved through Dere-i-Sendan, termed a glen in the narrative, but which, according to the account (p. 231), appears to be a regular extensive cañon, with perpendicular walls of an average height of about five hundred feet. Unfortunately, Dr. Jaworskij does not seem to have paid much attention to the geological features of the country traversed, for his observations in this respect are more than meagre. To go into the interesting details of the voyage to Kabul, would exceed the limits of these columns, and we therefore have to refer the reader to the volume itself. It may suffice here to state that the first mountain pass crossed on the way to Bamian was that of Tshembarak; but we cannot omit mentioning the description of the vast caves in the Bamian valley, and the colossal stone images, representing human figures, which adorn their entrances. These rude statues, hewn out of the native rock (a conglomerate, according to the author), with which they are still connected by their backs, vividly remind us of the sculptures of Easter Island. They are represented on the plate facing p. 280. The entrances to the caves open between the legs of these images, which are loosely draped, and whose sex remains doubtful. It would be of interest and importance to unveil the true character of the dark round spots scattered over the apparently perpendicular and projecting narrow surface, which reaches from the ground almost to the broken-off elbow of the largest figure on the above-named plate. Until better informed, we should feel inclined to consider them as so-called cup-cuttings.

Having traversed the Sefid Khak, the last mountain pass to be crossed, the embassy, on approaching the goal of their voyage, were met by a vesir, who gave them a warm, brotherly welcome. He embraced the general and his officers, placed his saddle-elephants at their disposal, and escorted them to Kabul, where spacious quarters had been provided for them by

order of the emir, who sent word that he would be happy to receive them. The day following the friendly reception, the Russian ambassador examined the presents sent by the governor-general of Turkestan to be delivered to the chieftain, and found to his great dismay that they consisted of almost worthless things. According to the author, they were shabby to behold, and beyond the most indulgent criticism. Gen. Stolettoff, anxious to prevent the reputation of his country from being damaged by a fraudulent governor, selected three of his best horses given him by the emir of Bokhara. He had them provided with richly ornamented Bokharian saddles, with brocade blankets, and the officers cheerfully added their silver tea-set, most of their plate, some costly fire-arms, and various other valuable objects. The emir graciously accepted these gifts, sending in return 11,000 rupees, which, after some remonstrance, had to be accepted by the Russians in order not to offend the princely donor.

During their sojourn at Kabul, two events of importance took place. The heir to the throne of Afghanistan died after an illness of only a few days. In consequence thereof, the paragraph in the projected Afghano-Russian convention, that "the imperial Russian government recognizes Abdullah-Dshan as heir to the throne of Afghanistan," was changed as follows: "The Russian government is ready to recognize as heirs such persons as may be nominated by Emir Shir-Ali-Khan."

Shortly afterwards the emir received the unexpected message that an English embassy was under way to pay their respects to him, and that he should receive them "according to the usage of hospitality becoming to a good neighbor of India." This piece of news was surprising, for two years previous the emir had entirely fallen out with the English. Under these conditions, he could by no means receive the embassy. Like a good diplomate, he used the recent death of his son as a pretext, and informed them that he was in mourning; but to no effect. The English insisted upon being received. After holding a consultation with the Russian general, he sent them the only possible answer: he emphatically declined to receive them.

On the 11th of August, Gen. Stolettoff, accompanied only by the author and a number of Cossacks, suddenly left Kabul. Twenty days later, they again reached Samarkand, after an absence of almost fifteen months. The rest of his staff had been directed to remain at Kabul to await further orders.

We regret that we can dwell no longer upon this interesting and timely work, but we hope that we shall soon have an opportunity of reviewing the second volume, which has not reached us. We wish the translator might have displayed a little more artistic taste. That he has performed his work with minute correctness, cannot be denied; but his German style is by no means elegant. Sentences like the following, — '*Ich wollte furchtbar schlafen*,' or '*Sie werden sich zerschlagen*' (p. 137), — remind us too vividly of the idiom used by Señor Pedro Carolino in his 'English as she is spoke.' It is true that he states in his preface that he had attempted to render his translation as correct as possible; but we are far from even admiring the language of his introduction. We are, however, indebted to him for a better track-map than the one in the original, though the orthography of the names in the text does not always agree with that on the map.

THE RUSSIANS AT THE GATES OF HERAT.

No higher compliment could be paid to Mr. Marvin's little book than the fact, that, within ten days after it appeared, it formed the basis of leading articles on the Afghan dispute in nearly all the principal papers in the country, and in most of them without any acknowledgment. No one but a man who had made a most careful study of the subject could have condensed so much, and such timely, information in such small space and on such short notice. The preface bears the date of March 23; and the book gives the clearest possible insight into the progress of Russia's advance from the Caspian during the last few years, the purpose and aim of her movements, the origin of the boundary dispute, and its condition on the date named. With the aid of this book, the telegrams in the daily papers become clear and intelligible, and any one can follow the development of events hereafter with a clear understanding of them.

Mr. Marvin has passed a considerable part of his life among the Russians, and understands their language. While he is naturally alarmed at Russia's progress, and opposed to her intentions, yet he writes in a calm and moderate tone. He always strives to be just, and comes as near being so as is possible when one is a party to a controversy. In his inter-

The Russians at the gates of Herat. By CHARLES MARVIN. New York, *Charles Scribner's sons*, 1885. 10+185 p., illustr. 16°.

course with the Russians during the last five years, he has gained a clear conception of what is the real object of Russia's advance across central Asia, and he is the first to explain it in the English language. It can be summed up in the phrase of Gen. Skobeleff: "Russia does not want India, she wants the Bosphorus." It is England that maintains the Turk on the Bosphorus, and prevents Russia from taking it: hence Russia seeks a position from which she can threaten England with disaster, if she continues her opposition; and this position is on the frontier of India. To suppose that any body of Russians has ever seriously contemplated the conquest of India, is a mistake; but it is a fact, that the great mass of the Russian army firmly believes that England holds India by a feeble tenure, that a small force of Russian troops could cause an uprising in India which would overthrow the English rule, and that, when Russia possesses certain points on the Indian frontier from which it can injure the English, the latter will come to terms about the Bosphorus. These ideas first began to spread in Russia after the Crimean war, but they received a tremendous accession in consequence of the action of England in 1878. Their chief advocate was Skobeleff, who had taken part in several of the campaigns in central Asia, and was marvellously familiar with the Asiatic question in all its bearings.

In pursuing this advance to the borders of India, Russia has acted on two lines; and Mr. Marvin dwells at length upon this fact, so as to avoid the confusion which vague notions of geography have caused in England. The first line, which was followed from 1863 to 1876, was from Orenburg south-eastward across Turkestan. This movement practically ceased with the conquest of Khokand or Ferghana, and the virtual subjugation of Bokhara in 1876. It gave Russia a territory about as large as France, Germany, and Austria combined, added something to her trade, and brought her armies to the base of the lofty mountains in the eastern part of Afghanistan, and only 300 miles from the north-west provinces of India.

The second movement began in 1879. Its starting-point was the eastern shore of the Caspian (about a thousand miles south of Orenburg), where Russia had gained a foothold ten years before. It has progressed, with extraordinary rapidity, eastward through Turkmenia, or the country of the nomad Turkomen, lying between Persia and the desert on the north. It reached Merv, six hundred miles from the Caspian, in 1884; and this year it was nearing Herat, when the English took alarm, and endeavored to fix a limit by marking the boundary of Afghanistan as the line which could not be crossed except as an act of war.

These two movements have therefore attained their full development; and the object of them is accomplished, for Russia is now practically on the borders of India, ready to strike a vigorous blow whenever the moment seems propitious. She has a line of railway and steamboat all the way from St. Petersburg and Moscow to a short distance behind her advance post at Panj Deh; and she can move half a million men against Herat with far more ease and safety than she moved them into Turkey in 1877. And from Herat there are no physical obstacles to prevent a march on India; for, according to Mr. Marvin, one can drive a coach and four all the way.

This is in brief the situation of affairs to-day, as delineated with the utmost lucidity in Mr. Marvin's excellent little book. He accuses Russia of bad faith in her movements: so have France and other nations accused England in the past, until 'perfidious Albion' has come to be a by-word. Such accusations, and the arguments in support of them, count for little with disinterested spectators. What they desire to know are accomplished facts, and it is in the presentation of these that the merit of this book consists. Few people, even among those who have tried to follow this trans-Caspian movement, have realized what it has already accomplished, and how pregnant it is with great events for the near future. What was scouted in parliament only four years ago as an idle dream, is to-day a reality, an existing state of affairs. It finds the English unprepared, undecided, bewildered, as to their proper course. In front of them is a nation which they have succeeded in converting into their inveterate enemy, patient, crafty, determined, with a clear understanding of its own intentions, and a willingness to make any sacrifices in support of them. If England will agree with her about the Bosphorus, Russia will be at peace, and even retire from central Asia: if not, a terrible war must ensue, not necessarily now, but in the near future, — a war in which all the advantages of position will be on the side of Russia. The probable result of such a war is a matter of the widest speculation, and no one can foretell it. It is enough now to know and understand the existing state of affairs, and this Mr. Marvin has enabled us to do.

TIFLIS AND BAKU.

After having laboriously waded through half a dozen of the ponderous tomes with which English travellers — and American too, for that matter — conscientiously afflict mankind, it is really a pleasure to take up this light, and we fear ephemeral, narrative of the exploits of Mr. Orsolle. To be sure, there are few dates and no statistics in the volume. Neither are there any pictures, not even a portrait of the author. There is a map, but as it was evidently drawn to illustrate a condition of affairs considerably anterior to our author's journey, and as no attempt seems to have been made to adapt it to the book it accompanies, it is of little use; nevertheless, it is a good map, in its way, and, a few years ago, might have been regarded with a more favorable eye.

It was in July, 1882, that Orsolle said good-by to his mother, and made the best of his way to the 'gare du nord,' where his travelling companion, M. Ad. Nihlein joined him. Thence by Cracow, Odessa, and Sebastopol, he proceeded to Poti, where he arrived on the 14th of August. From Poti, at that time the Black-Sea terminus of the Caucasus railway, he journeyed to Tiflis. His description of the latter place occupies a dozen pages, and will well repay a cursory perusal. At Tiflis he left the railroad, and travelled in the manner of the country, which he found much more agreeable than did O'Donovan, to Kars, the ruins of the ancient city of Ani, of which a plan is given, and Erivan. Thence, by a route not to be traced on the 'Carte pour le voyage de M. Orsolle,' he found his way to the Tiflis-Baku railway, and eventually to the Caspian itself.

There are many descriptions of Baku in the books, but none so interesting as this. M. Orsolle does not tell us how many gallons of oil are refined per hour, nor does he go into the details of the use of the refuse products of that distillation on the Caspian steamers. He gives no information on such points; but he does tell us what Baku is like, who its denizens are, and how they eat, drink, play, bathe, and exist. We say exist, because, judging from this description, it is a bare existence that the Bakunians lead in their naphtha-soaked town, which, he says, is destined to become the Marseilles of the Caspian.

The remainder of the book is devoted to Teheran and north-western Persia, and possesses no especial interest at the present time.

Le Caucase et la Perse. Par E. Orsolle. Paris, *Plon*, 1885.

NOTES AND NEWS.

The following is a complete list of the papers read at the meeting of the National academy of sciences, April 21-24:—J. S. Billings and Dr. Matthews, U.S.A., Methods of measuring the cubic capacity of crania; S. H. Scudder, Winged insects from a paleontological point of view; A. S. Packard, The Syncarida, a hitherto undescribed group of extinct malacostracous Crustacea, The Gampsonychidae, an undescribed family of fossil schizopod Crustacea, The Anthracaridae, a family of carboniferous macrurous decapod Crustacea, allied to the Eryonidae; Alexander Agassiz, The coral reefs of the Sandwich Islands, The origin of the fauna and flora of the Sandwich Islands; T. Sterry Hunt, The classification of natural silicates; Elias Loomis, The cause of the progressive movement of areas of low pressure; C. B. Comstock, The ratio of the metre to the yard; C. H. F. Peters, An account of certain stars observed by Flamsteed, supposed to have disappeared; J. E. Hilgard and A. Lindenkohl, The submarine geology of the approaches to New York; Theodore Gill, The orders of fishes; J. W. Powell, The organization of the tribe; G. W. Hill, On certain lunar inequalities due to the action of Jupiter, and discovered by Mr. E. Neison, E. D. Cope, The pretertiary Vertebrata of Brazil, The phylogeny of the placental Mammalia; C. A. Young, Some recent observations upon the rotation and surface-markings of Jupiter; H. A. Rowland, On the value of the ohm; F. A. Genth and Gerhard vom Rath, On the vanadium minerals — vanadinite, endlichite, and descloizite — and on iodyrite, from the Sierra Grande Mine, Lake Valley, N. Mex.; A. N. Skinner (by invitation), On the total solar eclipse of Aug. 28, 1886; Theodore Gill and John A. Ryder, The evolution and homologies of the flukes of cetaceans and sirenians; Ira Remsen, Chemical action in a magnetic field; A. Graham Bell, The measurement of hearing-power; A. Graham Bell and F. Della Torre, On the possibility of obtaining echoes from ships and icebergs in a fog. The following biographical notices of deceased members were also presented: of Dr. J. J. Woodward, U.S.A., by J. S. Billings; of Gen. A. A. Humphreys, U.S.A., by H. L. Abbot; and of William Stimpson, by Theodore Gill.

— At a recent meeting of the Bavarian geographical society, Professor Rutzel communicated some particulars concerning a map which he is designing to show the political circumstances of Africa; the actual limits of the various states, native and other, being defined according to the extent of the territories actually possessed by each. The map will show several 'centres' of state formation. The whole of the continent is, however, far from being divided amongst the existing tribes, as there are many districts which do not belong to any of them. The existing native states, moreover, such as the Sunda and the Zulu kingdoms, are of varying importance, and subject to very different systems. The native states, it is asserted, rest mainly on the boundary between the Sahara and the Sudan, the high plateau of east Africa, and the Guinea coast. The remain-

ing territories, so far as they are not occupied by European powers, are free from any form of state rule or possession.

— Bouquet de la Grye is ordered by the French ministry of instruction to proceed to Teneriffe, in order to study the laws of gravitation under all the circumstances for which the Peak offers facilities.

— Dr. Pechuel Lösche reports curious changes in the physical geography of Africa: "Lake Ngami is dried up; the game has died or gone away; the vegetation exists no longer; both the Okavango and the Tamakan flow into the Zambezi." Dr. Pechuel Lösche returns to Europe with rich collections, including a living Welwitschia, perhaps a new species of that curious plant.

— Dr. Lenz will leave Vienna in May for the upper Kongo, whence he will endeavor to cross the old equatorial province of Egypt in order to establish relations with Emir Bey and Lupton Bey's party.

— Dr. Silvers of Hamburg, who left that town in October, 1884, on an exploring expedition to the Cordillera of Merida in Venezuela, arrived at Tovar on Jan. 9, and from there will commence his explorations.

— The *Sémaphore de Marseille* reports a method of sugar-manufacture which is to supersede beet-root by potatoes, the saccharine matter being extracted by the help of electricity. Paris capitalists, and even English, are reported to be interested in the invention.

— The Marine biological association of England has already raised six thousand pounds of the fund required to found a station on the south coast of England, but requires four thousand pounds more before beginning to build. Cambridge has undertaken to raise five hundred pounds.

— A correspondent of the *Oesterreichische monatsschrift für den orient* writes, that if the reports of the few parties who have succeeded in gaining personal knowledge of the interior of the celestial empire did not agree in the fact that a kingdom of four hundred million inhabitants awaits the products of European factories, which will be opened to commerce by the introduction of modern means of intercourse, the beginning of the development of European industries in the interior, as evidenced in the last few years, would awaken immediate and serious anxiety for the future of the English trade. Led by their position, Hong-Kong and Shanghai are setting a good example in this direction to the other places which come in contact with European civilization. Hong-Kong has at present three large sugar-refineries, a spirit-distillery, a cordage-mill supplied with modern machines, and an ice-factory. Besides these, there are large glass and iron works, and an arrack-distillery, in course of construction; while the Chinese carry on woollen and cinnabar works in great style and with modern improvements. In Shanghai, to the establishments which have existed for several years, there was added, a few months ago, a new one of considerable importance, — the paper-factory of the Shanghai paper-mill company, which makes common and medium fine papers out of rags. This factory, established by Umpherston & Co. of Leith, and quite up to time in its plant, produces, on an average, two tons of paper a day; and later the production will be increased. It is under European direction, and employs only Chinese workmen.

— With a view to effectually prosecute marine fish-culture on sound scientific principles, the English national fish-culture association has under consideration a scheme for carrying out a series of observations on the temperature of the sea at various stages, in order to obtain a more thorough and concise knowledge of fish, their habits, food, etc. Thermometers for this purpose will be distributed to those selected for observers under certain rules and regulations.

— From experiments carried on by the French commission for the scientific study of firedamp, it is found that the most violent explosion takes place when there are 13 parts of air to 100 of firedamp, and that above or below this the explosion diminishes in violence. When the mixture is below 7 parts in 100, or above 18 in 100, the gas simply burns with its characteristic blue flame. The singing noise often heard in mines is ascribed to the escape of gas from many minute cavities; while it must exist in some places in vast quantities, as is witnessed by its use for illuminating-purposes.

— Prof. J. A. Ewing of University college, Dundee, has communicated a paper to the Royal society, which contains several points of immediate practical importance. He finds, for example, that the 'dissipation of energy' by reversal of magnetism is very much smaller in soft iron than in hard iron or steel, and even in the latter its amount is trifling; so that the principal part of the heat which is produced in the cores of electro-magnets must be due chiefly to other causes than the 'static hysteresis,' or static lagging action observed by Professor Ewing, and is, in fact, due almost wholly to the induction of so-called Foucault currents in the cores. The effects of this action are also almost entirely removable by vibrating a piece of soft iron during the application and removal of magnetizing force, and the iron is then found to possess almost no retentiveness; but, when the application and removal of magnetizing force are effected without mechanical disturbance, the retentiveness of soft iron is found to be even greater than that of steel. In some cases ninety-three per cent of the whole induced magnetism of a piece of annealed iron was found to remain on the complete removal of the magnetizing force. Examples were given to show that the influence of permanent set in the curve of magnetism is so marked as to give a criterion by which a strained piece may be readily distinguished from an annealed piece of metal; and that strain diminishes very greatly the magnetic retentiveness of iron.

— Capt. Hoffmann of the German navy has prepared a valuable pamphlet on ocean-currents (Zur mechanik der meeresströmungen an der oberfläche der oceane, Berlin, 1884), which gives a better

general presentation of theory and fact than any work we have seen. The value of the winds as the chief motive force, and the inefficacy of gravity brought into play by changes of temperature, are clearly made out, so far as surface-currents are concerned. The part played by the deflective forces coming from the earth's rotation is also well stated. So long as the surface-waters are brushed along by the wind in any given direction, the tendency to depart from this direction is practically overcome by the wind itself; but, whenever the waters set in motion by the wind enter a region of calm, they at once begin to describe the 'inertia curve,' — a line whose radius of curvature decreases with the sine of the latitude. Already in latitude 5°, this radius of curvature for a velocity of one metre a second is only forty-two and a half nautical miles: hence, when the South-Atlantic current runs into the region of calms just north of the equator, its waters will quickly turn to the right, easily falling into the power of the south-west monsoon of that region, and so forming the Guinea current, and, during the northern summer, the equatorial counter-current as well. The author therefore concludes, that, after the winds and the configuration of the coasts, the diurnal rotation of the earth must be recognized as the most important factor in determining the existing system of ocean-currents.

— Messrs. Sampson Low & Co. of London announce 'Under the rays of the aurora borealis, in the land of the Lapps and Kvaens,' — an original work by Dr. Sophus Tromholt, edited by Mr. Carl Siewers. The book contains an account of the work of the recent circumpolar scientific expeditions, and an exposition of our present knowledge of the aurora borealis, to the study of which the author has devoted the greater part of his life.

— The second session of the summer course of botany at McGill college, Montreal, will be opened to ladies on Tuesday, May 5. The course, which will be in charge of Professor Penhallow, will continue for seven weeks. It is designed to give practical instruction in general morphology, including the analysis and study of Canadian plants as found in the vicinity of Montreal. Instruction will also be given in histology with the microscope.

— In the annual report for 1884, of Prof. G. H. Cook, state geologist of New Jersey, there is a description of some remarkable recent changes in the condition of the land near South Amboy. A forest of common timber, such as oak and chestnut, standing on land ten or twelve feet above high-water mark, was cut down, and the underlying sands to a depth of twelve feet were stripped off preparatory to taking out the stoneware clays below; but, before reaching the latter, a swamp deposit a few feet thick, with white-cedar trees embedded in it, was passed through; and at the bottom of this, standing in the clay, were several oak stumps, at a level two feet below the adjacent salt-marsh, which is overflowed by high tides; and near the stumps there was a log about a foot in diameter, eight or ten feet long, that had been cut with an axe. There is no tradition telling of the burial of this forest, but it must have been less than two hundred and eighty years ago. The successive deposits are well shown in the excavation. The clay at the bottom; the old oak forest in the soil on this clay; then the black swamp-earth, and its small cedars embedded therein; finally the overlying plain of sand and gravel, with its late growth of upland timber, — with this, there is good evidence that the ground, which was formerly high enough above the level of the sea to sustain a growth of upland timber, is now so low that every tide could cover it with salt water. Some valuable figures are given in illustration of the superposition of glacial drift on unconsolidated tertiary clays, and of the columnar trap-rocks and water-bearing sands. The Green-Pond Mountain rocks, which were thought triassic by Rogers, and which were regarded as Potsdam in the earlier reports of the present survey, are now placed in the middle Devonian. The crystalline rocks of the Highlands, which have been called Laurentian on the strength of their lithological characters, are here prudently called simply archaean, in the absence of sufficient evidence to correlate and identify them.

— Major.-Gen. Sir F. J. Goldsmid has an article in the April number of the *Contemporary review* on Russia and the Afghan frontier. The gist of the article is, that the apathy with which the English government and people have hitherto watched the Russian advance from the Caspian towards India is due to a lamentable ignorance, on their part, of the geography and topography of central Asia. This is undoubtedly true; but how far the remedy proposed by the gallant general would be a remedy, is an altogether different matter.

— The Royal medals of the Royal geographical society, says *Nature*, this year were awarded to Mr. Joseph Thomson and Mr. H. E. O'Neill; to the former for his well-known work in Africa, and to the latter for his thirteen journeys of exploration along the coast and in the interior of Mozambique. The Murchison grant for 1885 was awarded to the Pandit Kreshna for his four explorations made while attached to the survey of India, and especially for his extensive and important journey in the interior of Tibet. The Back grant went to Mr. W. O. Hodkinson for his Australian explorations, and the Cuthbert Peek grant to Mr. J. T. Last for his surveys and ethnological researches in the southern Masai, Nguru, and other neighboring countries. The following were made honorary corresponding members: Chief-Justice Daly, president of the geographical society of New York; Mr. Elisée Reclus, the eminent geographer; and Herr Moritz von Déchy, the distinguished Austrian explorer of the Sikkim Himalayas, the Caucasus, and other regions.

— On the night of the 5th of April, the steamship Nurnberg, in latitude 49° north, longitude 18° 30′ west, during a very heavy storm from west-north-west, had mast-heads and yard-arms lighted with St. Elmo's lights. It was raining and hailing at the time, and the barometer showed 29.19. A ball of fire exploded during the storm, with a loud noise, similar to the explosion of a gun.

SCIENCE.

FRIDAY, MAY 8, 1885.

COMMENT AND CRITICISM.

In all branches of science where the observer deals with the forms of objects, it is more or less desirable that an average of the shapes of the objects should be attained. This end has hitherto been sought through a system of measurements, which is at best a clumsy method, suited only to determine the average of some single dimension; for, where it is the aim to present to the eye a normal or typical form, it is quite incompetent to serve the desired end. So far the beautiful method of composite photography devised by Francis Galton has only been applied to the human face, with the single exception of Dr. Billings's experiments in craniology: if it can be carried into no other fields, it will still remain one of the most important contributions to the graphic resources of science. But the naturalist who has felt the need of this resource in various directions is drawn to consider how far its use may be extended to other branches of inquiry. It seems at first sight that there may be use for it in obtaining the normal or average form of all objects which do not depart too far from a mean shape. It may be that the zoölogist or botanist who wishes to present a picture giving the normal aspect of a variable species, can, by selecting for delineation individuals of the same size, present to the eye a composite combining the general features, and neglecting the individual variations. In this way we shall be able to give to the term 'normal form' a definite and valuable meaning which has hitherto been wanting. It will also be remembered that the late Professor Agassiz laid particular stress on form as the underlying element of 'family' structure among animals; and this would seem to offer an opportunity to test experimentally the view held by the great naturalist.

It may also be hoped, that, in certain lines of inquiry in the inorganic world, this method of graphic averaging, this Galtonizing process, if we may so term it, will be of great use. Yet, important as are the prospects for the extension of this method of delineation to other fields of inquiry, its greatest use must be in the study of the human body. There this admirable process is full of promise. It may, for instance, be possible to secure an average picture of our school-children at different ages, which will give us a new measure of their condition, and so help us in what is perhaps the most important branch of social inquiry. The effect of occupations, and the results of different methods of physical culture, can also be accurately compared. It may be serviceable in testing the action of different systems of training on young soldiers, as also the influence of their accoutrements on the form of the body. So, too, the effects of certain diseases on the bodily form may be ascertained, to the great gain of medical science. Indeed, the possibilities of this method crowd on the mind. Practice may show limits to its use, and will doubtless do much to overcome certain difficulties evident at the outset of the work.

The charming composite photographs for which we are to-day indebted to Professor Pumpelly show the admirable results which may be obtained, and at the same time some of the critical difficulties of the process. No one can look upon them without a new respect for that shadowy thing called the normal man. There is a singular dignity in these combined shadows: they are strong faces, those of high-browed, deep-eyed, earnest-looking men, fit for all sorts of trials. But most of those who review the faces of American men of science will recognize that in figs. 2 and 3 one face appears, curiously, to dominate all the others, yet which, taken by itself, is perhaps the most

individual of all those contained in the plate. It would be interesting to know what effect on the composite its absence would produce. This element of what we may perhaps call prepotency is most likely to disturb these composite delineations; for, though in itself a very interesting phenomenon, it seems to be somewhat of an obstacle in this use of the new art. With this great contribution of Galton well in hand, we may at length hope that we shall be able to enter upon the study of that unexplored realm of the human face, and physiognomy become a tolerably exact science. Some such process as this seems to offer the only chance of obtaining valuable generalizations in this field of inquiry.

THE CITIZENS' committee of Montreal, formed to arrange for the entertainment of the British association last summer, has every reason to be congratulated on the success of its enterprise. Not only was the meeting a marked success in every point in which the citizens' committee had power to contribute to it, but the report presented at its final meeting a fortnight ago showed with what care it had employed the funds intrusted to it. Parliament granted $20,000 toward passage-money to the British members; and this was so carefully expended and accounted for, that there remains a considerable sum (about $2,600) to cover in to the treasury, — a new experience for a parliamentary grant of this sort. The Dominion government further voted $5,000 for general expenses, the corporation of Montreal an equal sum, and the citizens subscribed $4,580.97. This, too, has been managed with such care, that, apart from the expenses of the meeting, the committee is able to publish an edition of fifteen hundred copies, largely for gratuitous circulation, of a volume of economic papers, and then have on hand a surplus of $1,500. This the committee recommended should be given to McGill college in recognition of, and partial compensation for, its liberality in placing the building and grounds of the university at the disposal of the association. This was voted with the understanding that it should be used in some special way, such as for prizes or scholarships, to commemorate the meeting of the British association in Montreal. The success of the work of the committee was believed to be largely due to the excellent judgment and unwearied service of Mr. D. A. P. Watt and Lieut.-Col. Crawford, to the former of whom his associates presented a pleasing memento.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The ontogeny and phylogeny of the hypoglossal nerve.

IT cannot be otherwise than gratifying when two investigators, travelling along entirely distinct paths, unknown to each other, find themselves suddenly brought face to face upon the same stand-point. Haeckel's dictum, that the ontogeny of any form is a brief recapitulation of its phylogeny, is continually receiving confirmation, and, taking into consideration cenogenetic modifications, may be accepted as a dogma. If, then, a theory as to the past history of any form or organ which has been deduced from embryological data is also to be deduced (and that, too, independently) from comparative anatomical studies of adult forms, there are strong reasons for its acceptance.

A case of this kind has occurred quite recently. Since van Wijhe's interesting and important observations on the mesoderm segments of the elasmobranchs, the view that the hypoglossal nerve has been derived by a separation of fibres from the ventral roots of the vagus has very generally been accepted. In a paper very shortly to appear in the 'Studies from the biological laboratory of the Johns Hopkins university,' an entirely different view will be supported.

From a comparative study of the origin and distribution of the anterior cervical nerves in the various orders of the class Pisces, I have been led to the conclusion that the post-occipital nerves, as they may be termed, of Amia and other ganoid forms, are comparable to the anterior cervical nerves of the elasmobranchs, and in the teleosts and marsipobranchs have passed backwards, and become incorporated with the first spinal nerve. The apparent first spinal, therefore, represents three nerves. In the urodelous Amphibia, one finds, however, an arrangement more similar to what obtains in the elasmobranchs, there being in the anterior spinal region three distinct nerves, whose combined distribution resembles very closely that of the first spinal nerve of the teleosts, and may therefore be considered its equivalent. In the Anura there is a reduction in the number, the first nerve disappearing, or fusing with the second, so that two nerves here fulfil the function of the original three. In all these ichthyopsidan forms there is no true hypoglossal, this nerve making its appearance in the Sauropsida. From its distribution, it is apparently homologous with the three anterior spinal nerves of the urodelous Amphibia. As

a result of these comparisons, it may be concluded that the hypoglossal nerve of the Sauropsida and Mammalia is not a separation from the anterior roots of the vagus, but *is formed by the coalescence of a number — probably three — of anterior spinal nerves.*

Since the completion of my manuscript, the last number of the *Archiv für anatomie und physiologie* has been received; and therein is a paper by Professor Froriep of Tübingen, dealing, among other things, with this very point as to the origin and morphological relations of the hypoglossal. His observations were carried on by means of sections through very young sheep and cow embryos; and he was able to perceive that the hypoglossal at an early stage consisted of three distinct parts, which eventually unite; the union occurring first near the origin of the nerve, and proceeding centrifugally. To emphasize the similarity between Froriep's results based on embryological data, and my own deduced from anatomical facts, it will be well to quote a sentence from his paper. In summing up, he says, "The hypoglossus is formed by the union of a number of segmental spinal nerves, each of which is composed of two roots, — a ventral and a dorsal, — exactly like spinal nerves." J. Playfair McMurrich.

Johns Hopkins university, Baltimore, Md.

The Wisconsin bill relating to the instruction of deaf-mutes.

In *Science* (vol. v. p. 324) you state, that, until the present year, no special provision had been made in Wisconsin for the education of deaf-mutes. This is a mistake. The Wisconsin institution at Delavan, one of the best in the country, has been in successful operation since 1852, and two private schools are also in existence. The returns of the recent census, however, have shown that a large number of the deaf children of Wisconsin are growing up in ignorance, and that existing provisions for their instruction are inadequate. The bill that has just passed the Wisconsin legislature is an attempt to remedy the evil by a change in the policy of the state towards her deaf and dumb. The new plan may be tersely described as the policy of *decentralization.* The old policy of *centralization* — that is, the policy of collecting into one school all the deaf-mutes of a state — has everywhere failed to bring under instruction a large proportion of the deaf-mutes of school age. For example: there were in the United States in 1880, according to the last census, 15,059 deaf-mutes of school age (six to twenty years); while the total number of deaf-mutes returned as then in the institutions and schools of America was only 5,393, and many of these were beyond the school age. A similar result is obtained when we examine the statistics of each state taken separately.

Parents have a natural reluctance to part with their deaf children, who, more than others, require home care and attention. But education in an institution involves separation from home. Some parents will not part with their children excepting on compulsion; others delay the separation until the most impressionable period of life has been passed; and still others deprive their children of education on account of the value of their labor at home.

The nearer the school can be brought to the home of a deaf child, the less likelihood is there that he will escape instruction. The promoters of the Wisconsin bill believe that in many of the incorporated cities and villages of that state the deaf children could, with limited state aid, be educated in the localities where they reside; and that, if day-schools were established wherever possible, the institution at Delavan would be able to accommodate all who could not attend a day-school.

The bill grants state aid to any incorporated city or village supporting a school for deaf-mutes, to the extent of a hundred dollars per annum for every pupil instructed. The state appropriation alone will probably be sufficient to provide a teacher for a school of four or five deaf children; but even a school containing only one deaf child, which, of course, would have to be supported mainly from local sources, may, by complying with the provisions of the bill, receive state aid to the amount of a hundred dollars per annum.

Under such a law, there should be no excuse for lack of instruction. Public opinion will probably compel the education of deaf-mutes: for, if allowed to grow up without instruction, they very easily become dangerous members of society; while, if educated, they become good citizens, amenable to the laws of society, and sources of wealth to the state. If only as a measure of economy, the Wisconsin bill demands consideration; for the average per capita cost of the education of a deaf child in an American institution exceeds two hundred and twenty-three dollars, whereas the cost to the state, on the Wisconsin plan, is limited to a hundred dollars.

But other considerations are of still greater importance. It certainly seems reasonable to expect that the Wisconsin plan, consisting of a central institution and a large number of small day-schools scattered throughout the state, will bring under instruction a larger percentage of the deaf children of school age than would be possible on the institution plan alone. Instruction can also be commenced in the day-schools at an earlier age than heretofore; so that many pupils could receive preparatory instruction in a day-school before entering the institution, and thus be enabled to receive from the institution a higher and better education than they could otherwise hope to obtain.

Alexander Graham Bell.

Washington, D.C., April 27.

A complete fibula in an adult living carinate-bird.

The only known bird with a complete fibula is the Jurassic Archaeopteryx (Marsh, Dames). The fibula of all birds is complete during the early life of the embryo. I find in an adult Pandion carolinensis of Prof. O. C. Marsh's collection an entire fibula, but with the distal end of it not in front of the tibia, as in Archaeopteryx (Marsh). It would be interesting to examine the embryos of this bird; and I will be very much obliged to anybody who can send me any of them. Dr. G. Baur.

Yale-college museum, New Haven, Conn., April 24.

Digestion experiments.

I have read with some surprise the comments by Dr. E. Lewis Sturtevant in *Science*, April 24, upon my article on 'Errors in digestion experiments,' inasmuch as I had no intention, in that article, of asserting or implying any thing whatever in regard to other experiments of that character in this country. The purpose of the article was to call attention to the

rather large possible errors of the results of such experiments; and for that purpose I used the material nearest at hand. In order, however, to prevent any further misapprehension, I desire to say that I fully concede Dr. Sturtevant's claim to priority; although, owing to the fact that the bulletins of the New-York station are to be had at first hand only through the press of that state, I was not aware, at the time my results were first published (Bulletin No. 3 of the agricultural experiment-station of the University of Wisconsin, June, 1884), that he had anticipated me by three or four weeks.

I fully appreciate his remarks regarding the value of recognition, on the part of science, of scientific work at experiment-stations, and should regret exceedingly to seem to fail of doing whatever in me lies to secure such recognition. The field of agricultural science is too wide, and the workers in it far too few, to justify any professional jealousy.

H. P. ARMSBY.

Madison, Wis., April 30.

Tertiary phosphates in Alabama.

Since the publication of my two notes in *Science* last year, respecting the occurrence of phosphates in the cretaceous formation of this state, we have found that they occur also at at least two distinct horizons in the tertiary formation.

This formation in Alabama shows the following well-marked subdivisions, given in descending order: —

Vicksburg	175 (?) feet,	White limestone of Tuomey		Oligocene.
Jackson	60 "			
Claiborne	150 "	Claiborne,	Calcareous Claiborne of Hilgard,	Eocene.
Buhrstone	175–200 "		Siliceous Claiborne of Hilgard,	
Lignitic	1,000 "	Lignitic and flatwoods of Hilgard,		

The upper of these two divisions consists mainly of limestones, called throughout the country, and by Professor Tuomey, the 'white limestone.'

The lower division consists of sands and clays, which make up the greater proportion of the thousand feet or more of the strata of this group; but interstratified with these are five or six, and perhaps a greater number, of beds holding marine shells, the aggregate thickness of which may perhaps be given at a hundred feet.

Mr. D. W. Langdon, jun., of the state geological survey, while on a collecting tour for Mr. T. H. Aldrich, made the discoveries to which this note is intended to call attention.

At Nanafalia, on the Tombigbee River, there is a remarkable series of beds, over fifty feet in thickness, made up almost entirely of the shells of a small oyster (Gryphaea thirsae). At intervals throughout this thickness are projecting indurated ledges, holding the same shells, but forming a tolerably compact rock. A specimen from one of these hard ledges, one or two feet thick, has been analyzed by Mr. Langdon, and found to contain 6.7 % of phosphoric acid. Other parts of the Gryphaea beds may be similarly phosphatic, but no analyses have yet been made to show it.

This Nanafalia marl, which occupies a position nearly in the centre of the lignitic subdivision, occurs also on the Alabama River, at Gullette's and Black's Bluffs, and crops out between the two rivers in the lower part of Marengo county, where its presence is indicated by limy spots, or 'prairies,' of very great fertility. This marl contains also a very considerable percentage of greensand, and, apart from the phosphoric acid which it contains, would have become a valuable fertilizer.

The other phosphate-bearing horizon is in the lower or Jackson division of the white limestone.

At the base of the orbitoidal limestone which forms the greater part of the bluff at St. Stephen's, Mr. Langdon finds a hard ledge of rock holding Plagiostoma dumosa, and immediately beneath this, and extending fifteen feet down to the water's edge, a glauconitic marl holding numerous nodules or concretionary masses of phosphate of lime, — an occurrence quite similar to that of the nodules in the cretaceous beds at Hamburg in Perry county, described last year. Mr. Langdon's analysis of the greensand marl holding the nodules shows 0.6 % of phosphoric acid, while a sample of the nodules analyzed contains 22.68 % of phosphoric acid.

On the opposite side of the river, in Clarke county, similar materials have been collected and analyzed. A greenish glauconitic sand, occurring some three or four miles north of Coffeeville, contains 1.76 % of phosphoric acid.

Fifteen or twenty feet above this marl, there is a yellowish-brown loam holding soft yellow nodular masses varying in size from one inch to eighteen inches in diameter, and containing 2.74 % of phosphoric acid. This loam is probably formed by the disintegration of the Jackson limestone, the age of the stratum being indicated by the specimen of Plagiostoma dumosa which it contains.

Again: near Grove Hill, in Clarke county, one of my students, Mr. S. S. Pugh, has collected a number of phosphatic nodules which contain 19.48 % of phosphoric acid.

Where the argillaceous limestones of the Jackson age form the surface, they give rise, in their disintegration, to the rich limy or 'prairie' soils which characterize my 'Lime Hills' region,[1] which occurs over a good part of the counties of Choctaw, Washington, and Clarke. It is more than probable that the exceptional fertility of the soils of this region is in great measure due to the presence of these phosphates. In the upper part of the white limestone (Vicksburg), I have not yet been able to detect any unusual proportion of phosphoric acid.

In this connection it may be interesting to note that Mr. L. C. Johnson, of the U.S. geological survey, has traced the extension of the Alabama cretaceous phosphate beds into Mississippi, along the line pointed out by me in one of my notes above referred to. The occurrences in Mississippi are quite similar to those already described in this state.

EUGENE A. SMITH.

University of Alabama, April 20.

[1] Report on cotton-production in Alabama, p. 52.

PROGRESS OF THE LICK OBSERVATORY.

SOMETHING like a year ago, we reviewed the policy and operations of the Board of trustees of Mr. James Lick's bequest of about four millions of dollars for objects patriotic, charitable, and scientific, directing due attention to the conservative management of the estate, showing the utter folly of the attacks which have from time to time been made upon their official actions, and giving the best of reasons why all interested in the administration of this trust should uphold the board in the continuance of the policy which they have seen fit to adopt. The cessation of these impolitic hostilities is a matter of noteworthy significance, because of the relations of the bequest to the Lick observatory, and the other scientific objects which Mr. Lick thought worth gaining.

The trustees' first work — the construction of the great observatory on the summit of Mount Hamilton — has been prosecuted with such vigor during the past five years, that its completion at a definite epoch in the near future appears now to be a matter of certainty. It is only possible to say this because information has just been received from the glass-makers, Messrs. Feil and Mautois of Paris, that all serious difficulty in making the disk of crown-glass for the great telescope has at last been surmounted, — a difficulty which has already delayed the beginning of the opticians' work nearly three years, and has permitted the trustees to advance the remainder of the observatory to a finished state. The opticians now hope to be enabled to begin their labors upon this great object-glass by next August or September, and to complete their part of the contract within two years' time. This encouraging condition of affairs has been brought about largely by the recent action of the trustees themselves, who, desiring to complete as soon as possible their task of constructing and equipping the observatory, and finding that all further progress was conditional upon getting the necessary disk of glass, despatched a responsible agent to the eastern states, where he could be in consultation with prominent astronomers, and in ready communication with Paris.

The results of this action have been very satisfactory, and will enable the trustees to sketch the important outlines of their plans for future and final operations on the mountain. The fact that the glass is now to be obtained with reasonable certainty, has prepared the way for determining the size of the dome which will be required to cover the telescope when finally mounted. This building is already in process of erection, and will consume all the attention of the superintendent of construction for the next two seasons. The dome will have an interior diameter of seventy-three feet; and the telescope itself, whose exact length cannot yet be defined within narrow limits, will probably be fully sixty feet long, while, with the monster spectroscope attached, it may reach a length of nearly seventy feet from end to end.

Aside from this important end of securing the data necessary to avoid the entire cessation of work upon Mount Hamilton this summer, the agent of the trustees has also personally inspected the mountings of the great domes at Charlottesville, Washington, and Princeton, including the smaller ones at Harvard, Amherst, Columbia, and other colleges; and, on his return to San Francisco, he will report to the trustees on the information he has obtained, and recommend that plan for constructing and mounting the great dome which appears likely to insure in every way the best results. Any competent person who will take the trouble to consider the problem of building this dome from an astronomical and engineering point of view, will readily appreciate the nature of the obstacles to be overcome; but the eminently satisfactory arrangements devised, and already put into successful operation at this mountain observatory, will go a great way toward inspiring confidence in whatever form of dome the trustees finally decide to adopt. In an early issue, we shall place before our readers an account of the Lick observatory and its work, together with a fully illustrated description of the site, buildings, and instruments.

COMPOSITE PORTRAITS OF MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

THOSE of the members who were present at the Washington meeting of the academy last spring will remember, that, at the request of Professor Brewer and myself, they sat for their separate photographed portraits for the purpose of obtaining an experimental composite picture. Professor Baird kindly offered the facilities of the photographic department; and the pictures taken by Mr. Smilie, the photographer in charge, bear the same stamp of excellence that characterizes so generally the work of that department of the national museum.

As only one or two previous attempts, I believe, have been made to produce composites in this country, I will state briefly what they are, and how they are made.

The idea in its broadest sense was conceived and applied by Francis Galton for the purpose of obtaining an average or type portrait; i.e., a picture that should show the features that are common to a group of individuals, and exclude those that are purely individual. It is clear, that, in proportion as this result is attainable, the method will be of value in obtaining a clear conception of the external characteristics of any given type or class.

Galton reminds us, that, during the first days of a traveller's meeting with a very different race, he finds it impossible to distinguish one from another, without making a special effort to do so: to him the whole race looks alike, excepting distinctions of age and sex. The reason of this is, that, by short contacts with many individuals, he receives upon his retina, and has recorded upon his memory, a composite picture emphasizing only what is common to the race, and omitting the individualities. This also explains the common fact that resemblances among members of a family are more patent to strangers than to the relatives.

The individuals entering into these composites were all photographed in the same position. Two points were marked on the ground glass of the camera; and the instrument was moved at each sitting to make the eyes of the sitter exactly coincident with these points. The composites were made by my assistant, Mr. B. T. Putnam, who introduced the negatives successively into an apparatus carefully constructed by himself, and essentially like that designed by Mr. Galton, where they were photographed by transmitted light. The arrangements of the conditions of light, etc., were such that an aggregate exposure of sixty-two seconds would be sufficient to take a good picture. What was wanted, however, was not an impression of one portrait on the plate, but of all the thirty-one; and to do this required that the aggregate exposure of all the thirty-one should be sixty-two seconds, or only two seconds for each. Now, an exposure of two seconds is, under the adopted conditions, too short to produce a perceptible effect. It results from this, that only those features or lines that are common to all are perfectly given, and that what is common to a small number is only faintly given, while individualities are imperceptible. The greater the physical resemblances among the individuals, the better will be the composites. A composite of a family or of near relatives, where there is an underlying sameness of features, gives a very sharp and individual-looking picture.

It would be difficult to find thirty-one intelligent men more diverse among themselves as regards facial likeness than the academicians entering into this composite. They are a group selected as a type of the higher American intelligence in the field of abstract science, all but one or two being of American birth, and nearly all being of American ancestry for several generations. The faces give to me an idea of perfect equilibrium, of marked intelligence, and, what must be inseparable from the latter in a scientific investigator, of imaginativeness. The expression of absolute repose is doubtless due to the complete neutrality of the portraits.

Fig. 3 contains eighteen naturalists and thirteen mathematicians, whose average age is about 52 years. Fig. 1 contains twelve mathematicians, including both astronomers and physicists, whose average age is about $51\frac{2}{3}$ years. Fig. 2 is a composite of sixteen naturalists, including seven biologists, three chemists, and six geologists, with an average age of about $52\frac{1}{2}$ years.

I may mention, as perhaps only a remarkable coincidence, that the positives of the mathematicians, and also of the thirty-one academicians, suggested to me at once forcibly the face of a member of the academy who belongs to a family of mathematicians, but who happened not to be among the sitters for the composite. In the prints this resemblance is less strong, but in these it was observed quite independently by many members of the academy. So, also, in the positive of the naturalists, the face suggested, also quite independently to myself and many others, was that of a very eminent naturalist, deceased several years before the sitting for this composite.

There is given also a composite (fig. 4) of

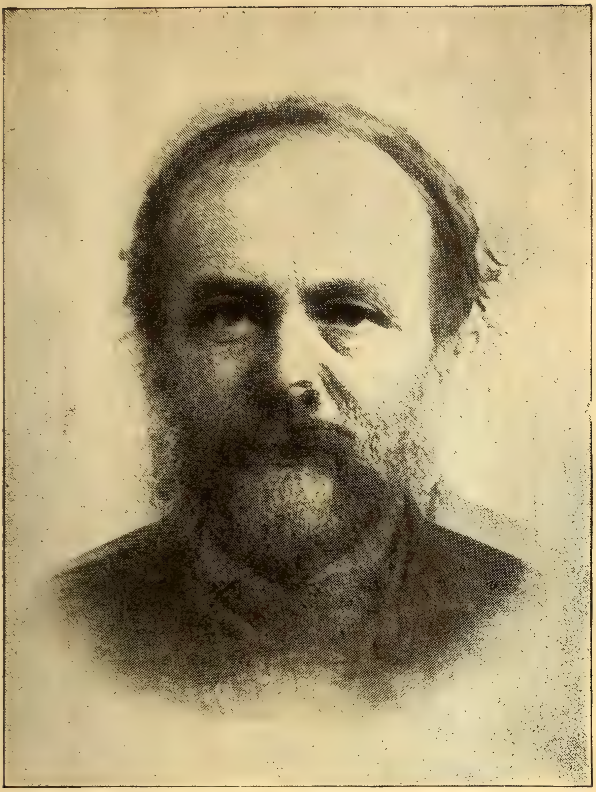


FIG. 1. — TWELVE MATHEMATICIANS.

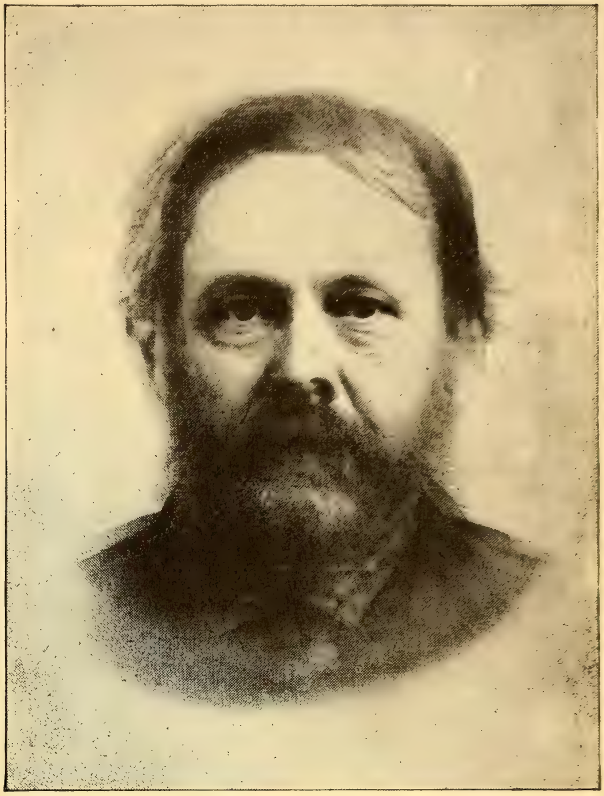


FIG. 2. — SIXTEEN NATURALISTS.

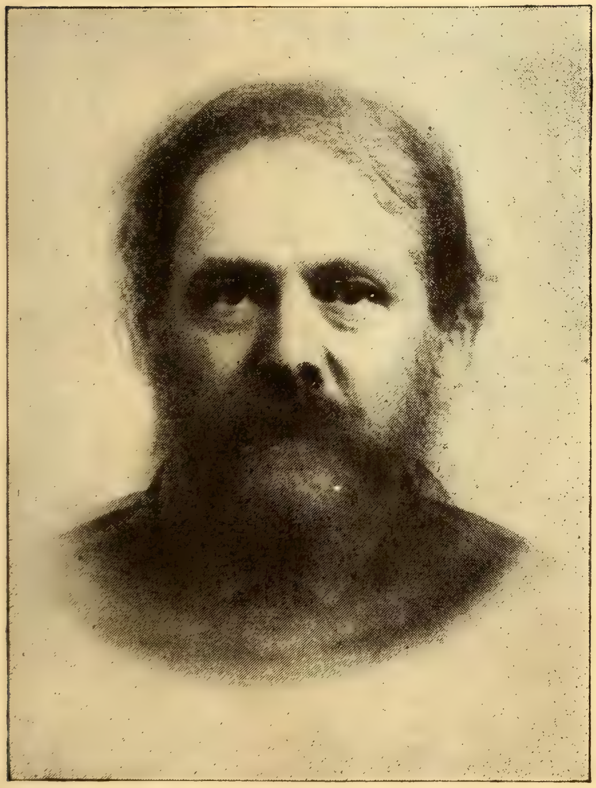


FIG. 3. — THIRTY-ONE ACADEMICIANS.

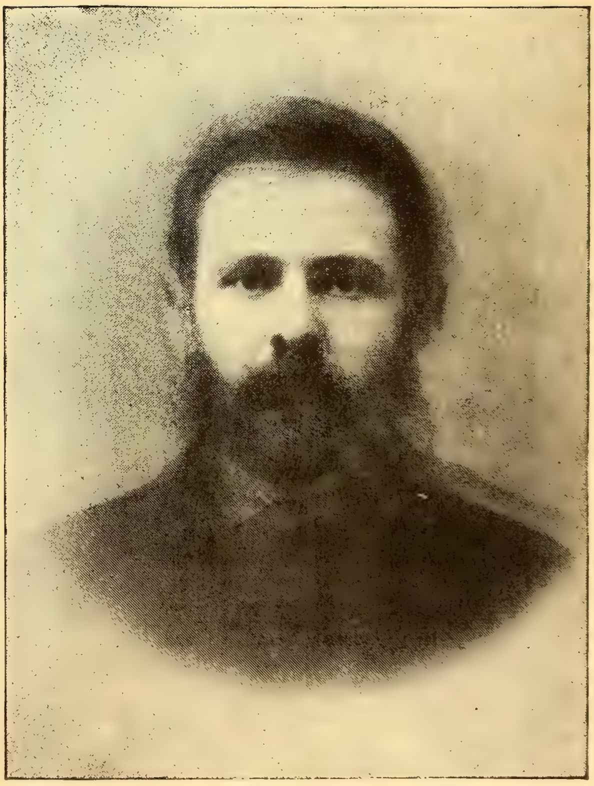


FIG. 4. — TWENTY-SIX FIELD-GEOLOGISTS, TOPOGRAPHERS, ETC.

COMPOSITE PORTRAITS OF AMERICAN SCIENTIFIC MEN.

SCIENCE, *May 8, 1885.*

a differently selected group. It is of twenty-six members of the corps of the Northern transcontinental survey, — an organization of which I had charge, and the object of which was an economic survey of the north-western territories. It was a corps of men carefully selected as thoroughly trained in their respective departments of applied geology, topography, and chemistry, and having the physique and energy, as well as intelligence, needed to execute such a task in face of many obstacles. The average age of this group was thirty years. RAPHAEL PUMPELLY.

MORTALITY EXPERIENCE OF THE CONNECTICUT MUTUAL LIFE-INSURANCE COMPANY.

THERE is a popular superstition, almost universal among our transatlantic cousins, and widely spread in our own country, that Americans are shortening their days by hard work, and inattention to the laws of healthy living. Our readers may remember, that, when Mr. Herbert Spencer first arrived in this country, he immediately began lecturing us on this subject. No surer test of this question can be found than that of mortality statistics, because those who insure their lives belong principally to the very class, who, according to the superstition, are most actively engaged in their own extermination. The tables recently published under the above title are therefore of great interest. The fulness of detail, and variety of form, in which the results are presented, facilitate their discussion. It therefore seems worth while to point out the most interesting results obtained. The fact thus brought out is, that at the very ages when mortality from over-work should most powerfully show itself, namely, from thirty to sixty, the American mortality is more than one-third less than the English, as shown by the combined experience table, and is constantly diminishing.

There are, however, reasons why we should not expect the death-rate shown by the experience of a life-insurance company to coincide with the rate amongst the community at large. Insured lives are not taken at random from the community, but form a select body. Only a limited class possess the foresight and interest in the future which would induce them to insure their lives. Out of that limited class, the insurance company selects only those whose viability is free from serious doubt. This selection, of course, tends to result in the insured class having better lives than the community at large. There is, however, a tendency in the opposite direction, which may be operative to a limited extent. A person who has reason to suspect his viability will have a stronger motive to get insured than one who does not. There is, however, no evidence that this cause has resulted in the lowering of the standard among the insured generally.

One result of the selection exercised by the company is obvious, and has frequently been pointed out by writers on the subject. Out of the class of men with good constitutions, the company selects only those who are, for the time being, in good health. With those who are going to die, symptoms of disease frequently appear weeks, months, or even years before actual death. The probability of a healthy person dying within the year following his examination by the life-insurance company is therefore less than the probability that he will die in the second year; and this, again, is still less than the probability that he will die in the third year. It has commonly been supposed that three years would have to elapse after the examination, before the probability reached its normal point. It is remarkable that the table now before us exhibits this effect in a much smaller degree than usual. The death-rate during the first two years of insurance is less by perhaps ten per cent than the general rate at all ages. During the third year it is actually less than during the second. Instead of attaining its maximum at the end of the third year, it continues to increase, and it does not reach the regular curve until the sixth year. It would seem that while the company gains a certain advantage during the first five years, through its privilege of selection, that advantage is far less during the first year than would have been supposed, and far less than common experience has hitherto shown it to be.

Another remarkable result, which we wish had been explained more fully, is the extraordinary death-rate among the younger class. This is more strongly shown among natives of the United States than among the insured at large. From the age of twenty-one to ninety, the death-rate follows the table of mortality very closely, but is uniformly from fifteen to twenty per-cent less than the tabular rate. But among native Americans, between the ages of seven and twenty, the rate is forty per cent greater than that given by the American table. The actual number of those who died was forty-seven, while the table gives only thirty-three deaths. The case is rendered yet more striking by the consideration that the mortality of the American table at the early ages is greater

than that of the combined experience table of the English companies. Above the age of thirty, the American mortality is decidedly less than the English, while at the earlier ages it is greater. The American table shows a maximum of advantage over the English experience about the age of fifty. The deaths at this age are about one in seventy-three by the American table, while the English table gives one death in sixty at this age. The experience before us greatly increases this discrepancy on the two sides of the Atlantic. At the age of fifty, the Connecticut company has only one death in ninety-three, against the numbers just stated for the English and American tables respectively. Perhaps the case is seen in the strongest light by remarking that the actual mortality at the ages from thirteen to twenty has been appreciably the same as at the ages from forty-six to fifty. Whether this extraordinary mortality is due to some special cause, is not clearly stated. If the lives which have been accepted by the company are representative ones of their class, it would seem that young Americans are subject to some extraordinary liability to death.

The insured are divided into forty-nine classes of occupations. It will perhaps sadden the reader to learn that travelling-agents, among whom book-agents are undoubtedly classed, seem to have the greatest viability of all. Taking them and lumber-men together, the death-rate is less than half that given by the tables. Dentists come third, and meet with the same fortunes as professors and teachers: for both classes the mortality is six-tenths that of the tables. How little mere occupation has to do with viability, is shown by the fact, that, while bankers and capitalists suffer one-fourth less, brokers, speculators, and operators suffer twelve per cent more than the tabular mortality. Officers of the navy, and of ocean and sailing vessels, have suffered the greatest comparative mortality of all, having died twice as fast as the general average of the insured. This is no doubt to be attributed to the civil war, which occurred during the time covered by the experience. Taking out this case as exceptional, the greatest mortality of all would be found amongst liquor refiners and dealers, bar-keepers, landlords, etc. This is quite in accord with general experience.

It is much to be desired that the mortality statistics of the census should be placed on a better basis. If the census office were to be made a permanent one, we might expect such a result to be attainable. S. Newcomb.

AMERICAN FLASH LANGUAGE IN 1798.

The cant or flash language, or thieves' jargon, was scarcely known, even by name, in the United States, until attention was drawn to it some forty years ago by the publication of Ainsworth's 'Rookwood' and 'Jack Sheppard,' followed by Dickens's 'Oliver Twist.' Even then it was regarded as a purely English product; and it was not until 1859 that Mr. G. W. Matsell, chief of police in New-York City, published a little work upon this dialect, showing that it had been to some extent transplanted to this side of the Atlantic. I am not aware that any mention has ever been made of the fact that there exists a full glossary of this thieves' jargon, as spoken nearly a century ago at the Castle in Boston harbor (now Fort Independence), which was used down to the year 1798 as a state penitentiary. The reason for this neglect lies, no doubt, in the fact that the book in which this glossary is given — 'The life and adventures of Henry Tufts' (Dover, N.H., 1807) — is an exceedingly rare one, having been, it is said, suppressed by the author's sons. It is not to be found in any public library in Cambridge or Boston; and the only copy I have ever seen was picked up by myself at an old book-store, many years since, and was presented to the Worcester, Mass., city library. In a paper to be published elsewhere, I have given some account of this singular book; but this glossary of terms deserves a separate treatment as a contribution toward the history of the American speech. There is nothing more curious than the vitality of a class of words never employed in good society, and never admitted into any dictionary. While we all claim theoretically that vocabularies, and even academies, are necessary for the preservation of a language, we yet find in practice that these base-born brats, these children of thieves and outcasts, have a vitality of their own. The profane or indecent phrases which boys hear at school, and which they repeat with bated breath if at all — these same words were heard at school by their grandfathers, and have led a hardy and disreputable existence ever since; yet they remain unchanged, and time has not, as Sir Charles Pomander said of his broken statues, 'impaired their indelicacy.' Tufts's list does not, for a wonder, stray into the domain of impropriety, though the rest of his book does; but he gives many words that can be traced through other similar dictionaries, many that occur in his glossary alone, and others that are now familiar, and are commonly supposed to be recent. I have re-

arranged his glossary in alphabetical form, and have in a few cases analyzed a phrase into its component words; but I have not altered his definitions. In the table that follows, his list of words will be found compared with various other lists of the same description.

The books which I have selected for comparison were published at various dates, some before and some after Tufts's glossary, which was compiled at least as early as 1798, he having been a prisoner at the Castle for the five years preceding. These books are as follows, arranged in order of date, and they are designated in the accompanying table by this date alone.

1573, Harman's (Thomas) 'Caveat for common cursetors,' reprinted in J. C. Hotten's 'Slang dictionary,' ed. 1873, p. 15.

1673, Head's (Richard) 'Canting academy, to which is added a compleat Canting Dictionary.'

1785, Grose's (Francis) 'Classical dictionary of the vulgar tongue.'

1790, Potter's (Henry T.) 'New dictionary of the cant and flash languages.'

1811, 'Lexicon Balatronicum' [founded on Grose].

1859, Matsell's (George W.) 'Dictionary of the thieves' jargon' [New York].

1873, Hotten's 'Slang dictionary,' a new edition.

Tufts's glossary, 1793–98 (Boston).

Blower	A woman	1673 (*blower*); 1785 (same); 1790; 1811; 1873.
Bonny lay	Highway robbery	[The best *lay*, or device.]
Briar	A saw	[Obvious analogy.]
Chant	Writing of any kind	1790 (*chaunt*, to make known); 1859 (same, and also *chant* = name).
Clout	A handkerchief	1859; 1873 (called 'old cant').
Cly	A pocket	1573; 1785; 1790; 1811; 1859; 1873 [Anglo-Saxon *clea*, claws?].
Cove	A man	1573 (*cofe*); 1673; 1785 (*cove* or *coffin*); 1790 (landlord); 1811; 1859 [found in Dekker's 'Wits' recreations'].
Crab	A shoe	1785 (*crab-shells*, Irish); 1811 (same); 1859 (same, and also *crabs* = feet); 1873.
Crabkin	A shoemaker's shop.	
Crack	To break open	1785; 1790; 1811; 1859; 1873.
Darky	Cloudy	1573 (*darkemans* = the night); 1673, 1785, 1790, 1811 (the same); 1873 (*darky* = twilight).
Dead up to, to be	To know well	[*Dead* = very, exceeding. Halliwell, North.]
Dinge	A dark night	[To *dinge* = to drizzle. Halliwell.]
Dingy cove	A negro	1785 (*dingy Christian* = a mulatto); 1811 (same).
Do	To rob	1785; 1811; 1873.
Douse the glim	To put out the light	1811; 1859; 1873 [*glin* or *glim*].
Drag	A prisoner	[One *dragged* by the police?]
Dub	A false key	1785; 1790 (*dubb the jigger* = lock the door); 1811; 1859.
Evening sneak	Going into a house at night, where the doors are open,	1785; 1790; 1811.
Flamer	Vitriol	[Inflamer?]
Flat	A foolish man	1785; 1790; 1811; 1859; 1873.
Gentleman	A crowbar.	
Glaze	A square of glass	1785 (*glazier* = a window-thief); 1811; 1859; 1873.
Glin	A star or light	1573 (*glimmar* = fire); 1673, 1790 (the same); 1811 (*glim*); 1859 (*glimsticks* = candlesticks); 1873 (*glim*).
Gorge	A person or fellow	1811 (*gorger* = a gentleman). [Gypsy, *gorgio*.]
Grub	Victuals	1785; 1790; 1811.
Hammers to you, I'm,	I know what you mean.	
Hookses	Neat-cattle.	
Horney	A sheriff	1790 (*hornees*); 1859 (*horness* = watchman).
Jarvel	A jacket.	
Jigger	A door	1573 (*gyger*); 1790; 1811 (*jig*); 1859; 1873.
Kickses	Breeches	1785 (*kicks*); 1790, 1811 (*kicks* or *kickseys*); 1859 (*kicksies*); 1873 (same).
Kin	A stone.	
Kinchen	A child	1573 (*kynchen*); 1673; 1785; 1790; 1811; 1859; 1873. [German, *kindchen*.]
Lay	[Mode of stealing]	1785; 1811; 1859; 1873.
Leg-bags	Stockings	[*Bags* = trousers, London *Punch*.]
Long tog	A coat	[*Toga*. Shaksp., *Togde*.]
Lour	Money	1573 (*Lowre*, a Wallachian gypsy word); 1673; 1785; 1790 (*lour* or *lower*); 1811; 1859 (*lowre*); 1873.
Mitre	A hat.	
Napping	Stealing	1673; 1785; 1790; 1811; 1859; 1873.
Napping his bib	Crying	1790; 1873.
Nipping-jig	A gallows	1673 (*nubbing cheat*).
Oliver	The moon	1790; 1859; 1873 ('nearly obsolete').
Petre yourself	Take care of yourself	1790 (*peterees* = thieves of *peters* or trunks); 1859 (*peter-biter* = same).
Pops	Pistols	1785; 1790; 1811; 1859; 1873.
Prad	A horse	1573 (*prauncer*); 1673 (*prancer*); 1790; 1811; 1859; 1873 ('old cant').
Pradholder	A bridle.	
Qua	A jail	1573 (*quyer ken*); 1673 (*queer ken*); 1790 (*quod*); 1873 (*quad* or *quod*, an abbreviation of quadrangle).
Quakeeper	A jailer.	
Quid	A guinea	1790; 1859 (*quid* = $5).
Quillpipes	Boots	1785 (*quailpipe boots*, so called because plaited like a quailpipe); 1811 (same).
Quisby	Mean	1785 (*quiz* = a strange-looking fellow); 1873 (*quisby* = an amplification of *queer*).
Roram	The sun	[Possibly a corruption of Rowland, to correspond to *Oliver* = the moon.]
Rum-blower	A gentlewoman	1785 (a handsome wench); 1790 (same); 1811 (same); 1859 (same).
Rum-cove	A gentleman	1785 (a dexterous rogue!); 1790 (a good landlord); 1811 (same as 1785).
Scrag a lay, to	To steal clothes from a hedge.	

Slangs	Irons	1790 (*slanged* = ironed); 1811; 1859 (*slanged;* also *slang* = watch-chain); 1873 (only a watch-chain).
Smish	A shirt	1573 (*mish* or *commission*); 1790 (*mish* or *smeesh*); 1811 (same as 1785); 1859 (*mish*); 1873 (both *mish* and *smish*).
Snuskin	A nail	[*Snuskin* = a delicate morceau. Halliwell.]
Spotted, you're	You are like to be found out,	1859 (*spot* = point out as suspected); 1873 (marked by the police). [Mentioned as 'recent' in Bartlett's 'Americanisms.']
Spread	A saddle.	
Star a glaze, to	To cut out a pane	1811; 1859; 1873.
Suck	Rum [liquor]	1785; 1790; 1811; 1859; 1873 (only *suck-casa* = a public-house).
Tapster	A dog	[Probably a mere variation of *Yapster*.]
Thumpkin	A barn of hay	[*Thumpkin* = a clown. Halliwell.]
Topt	Hanged	1673, 1785 (*topping cove* = the hangman); 1790; 1811; 1859; 1873.
Tonch, to	To rob	1785; 1790; 1811; 1859.
Trick	A watch	1859 (*trick* = any thing stolen by a pickpocket).
Undub, to	To unlock	1859 (*under-dubber* = turnkey).
Water-sneak	Breaking into a vessel	1785 (*waterpad* = robber of ships); 1790 (same).
Wheel	A dollar.	
Wibble	An anger	1785 (*wibble* = bad drink); 1811 (same); 1859 (same). [*Wimble* = an auger. Dryden.]
Yapster	A dog	[*Yap* = a cur. Halliwell.]

[When a date alone is given in the above table, the dictionary of that date gives both word and definition as Tufts gives them.]

It will be observed that a certain number of Tufts's words are not to be found in any of the books of English slang; while, from the correctness of the remainder, it is unlikely that he invented even these. The words *bonny lay* (robbery), *briar* (a saw), *drag* (a prisoner, i.e., one dragged?), *flamer* (vitriol), *gentleman* (a crowbar), *hammers to you* (implying comprehension), *hookses* (cattle), *jarvel* (a jacket), *kin* (a stone), *nipping-jig* (gallows), *roram* (the sun), *to scrag a lay* (to steal from a hedge), *snuskin* (a nail), *spread* (a saddle), *tapster* and *yapster* (a dog), *thumpkin* (a barn of hay), and *wheel* (a dollar), — these are not found in the other lists, and some of them are difficult to explain. Other phrases, though not elsewhere mentioned, are easy of derivation; as *crabkin* (crabken?), *dead up to* (like dead sure), *dinge* (dingy), *leg-bags* (stockings), *long togs* (long-clothes), *mitre* (hat), and *pradholder* (bridle). In a few cases the phrase is preserved by Matsell (1859) as a part of American slang, although not now to be found in the English slang dictionaries; thus, *trick*, in the sense of something stolen, and *undub* (unlock), which apparently survives here in the phrase *under-dubber* (turnkey). In regard to any word untraced, I should be glad of suggestions. T. W. HIGGINSON.

Cambridge, Mass.

WALKING AND RUNNING.[1]

ALTHOUGH every one pretends to know how to walk and run, still there are few who do not make useless effort; and the few good runners or walkers are not necessarily those with great muscular force, or power to withstand fatigue, or those who have merely a special aptitude in this direction, but rather the persons who by training have found, little by little, the best possible means of using their natural powers. They are incapable of transmitting the secret of their ability, and, indeed, they hardly have time to reflect upon the movements which they execute so mechanically. It is hoped that by means of the camera this secret can be found.

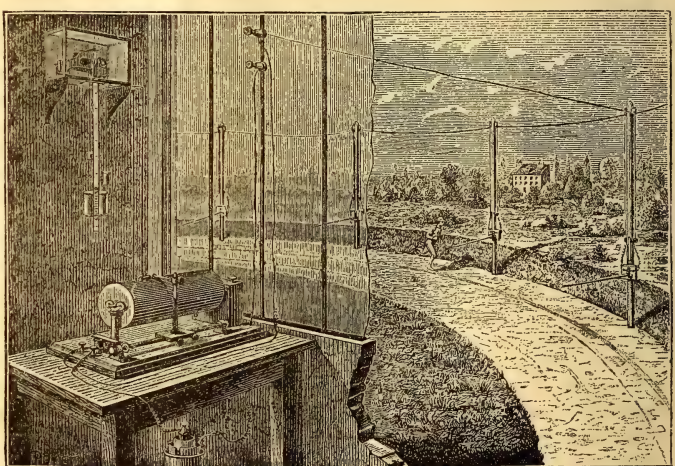


FIG. 1.

Experiments have been undertaken at the physiological station in Paris to study these movements. In fig. 1 a man is seen running upon the experiment-track, and in the same figure the recording apparatus is shown. A telegraph-line, resting upon poles placed fifty metres apart, reaches around the track, which is half a kilometre in circumference. The runner, as he passes each post, finds his course barred by a horizontal rod (fig. 2), which gives way before the slightest pressure, but which cannot be moved without causing an interruption in the circuit of the telegraph-line. This interruption records itself in the laboratory

[1] Abridged from *La Nature.*

by displacing a crayon, which traces upon a turning cylinder covered with a sheet of paper.

The mechanism of the electric interrupter is very simple, as shown in fig. 3. The rod which bars the

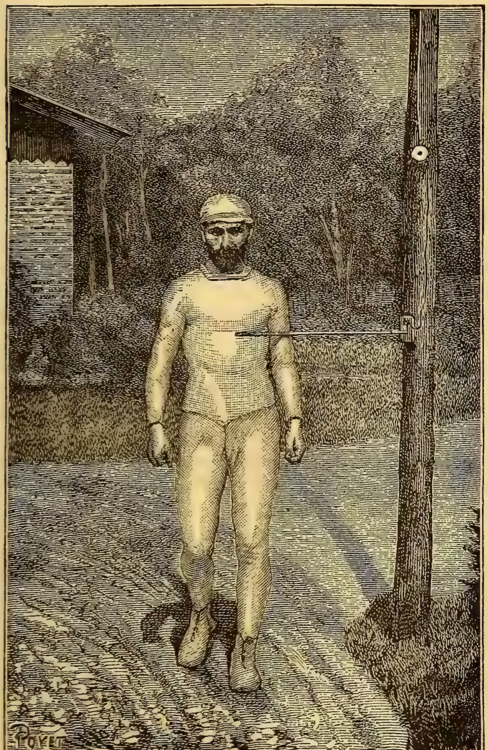


Fig. 2.

track is so arranged that it slides up an inclined plane every time it is displaced, and in so doing presses upon a spring, which, displacing a button of metal, breaks the circuit. The rod immediately returns to its original position, and the interrupted current re-establishes itself. At each breaking of the current, the wheel-work of the recording apparatus, freed for a moment, moves, and makes the crayon advance on the paper. The paper-covered cylinder turns uniformly, the rate of rotation being such as to cause the paper to pass in front of the crayon at the rate of half a centimetre per minute. On the other hand, the crayon is allowed to move only when the current is interrupted. The crayon progresses at each rupture of the current only a constant distance.

After a person has travelled around the track, the paper bears a sinuous line similar to that in (*a*), fig. 4. In the diagram the time is scored horizontally, the minute spaces equalling half a centimetre. The interruptions score themselves vertically, each upward step showing that the pedestrian has gone fifty metres: hence the course (*a*) corresponds to a march of twelve hundred metres in fifteen minutes, thirty-five seconds. In drawing a line connecting the angles of the sinuous line, we have a simpler expression of the march, as seen in the lines *b*, *c*, *d*, etc., which, by their greater or less inclination, show that the gait has been more or less rapid. The line (*i*), for instance, corresponds to a run of sixteen hundred metres in nine minutes and a half, while (*c*) corresponds to a march of seven hundred and fifty metres in sixteen minutes.

By gathering outlines from hours of marching, we have much more interesting records, in which the effects of fatigue are plainly seen, all irregularities in speed being faithfully recorded by the rise or fall of the line.

The shape of the boot has considerable effect upon the quickness of the march. In order to determine the best form of marching-boots, buskins have been made with heels which can be regulated, by removing plates, so as to be of any height from half a centimetre to six centimetres. From the experiments it is seen that the quickness of the step increases in proportion to decrease in height of heel. This result tends to an increase in the length of the step, and it is also noticed that the step increases in length and quickness when the length of the sole considerably exceeds that of the foot. Beyond a certain limit, however, the precise determination of which can only be made after many experiments, the length of the sole causes a noticeable fatigue.

The rhythm of the drum or clarion guiding the steps of soldiers has marked effect upon their speed. This problem is very complex. The acceleration of the rhythm may increase the speed to the rate of eighty steps per minute; but beyond this the increased frequency of the steps causes a slackening in the rate of march. In order to experiment upon this, an electric bell, placed in the centre of the track, is rung by a pendulum, represented above and to the left in fig. 1. The rate of ringing can be regulated, and the walker finds it impossible to keep out of step with the strokes of the bell. Starting the bell so as to cause the man to take forty steps per minute, then gradually making it more rapid, it is seen that the

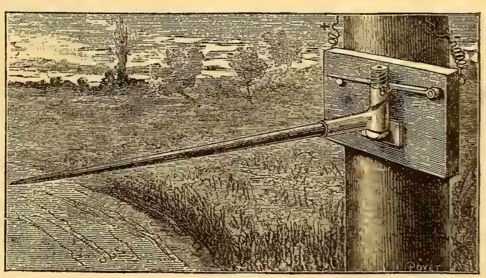


Fig. 3.

time taken to run a kilometre varies greatly. The length of the steps is simply deducted from the number of oscillations of the pendulum during a tour of the track, which represents a well-known course.

Experiments show that the progressive acceleration of the rhythm brings about the modifications represented in the following table. The acceleration of rhythm from sixty to eighty steps per minute has

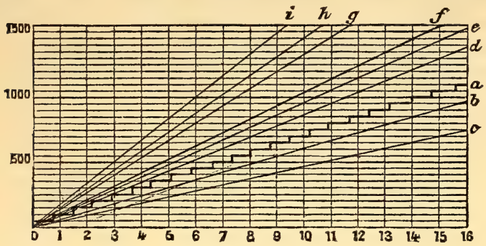


Fig. 4.

increased the length of the step, and decreased the time required to travel a certain distance; but, when we go above this, the opposite effect is produced. It is better to replace the numerical table by the diagram of fig. 5, which represents the variations in

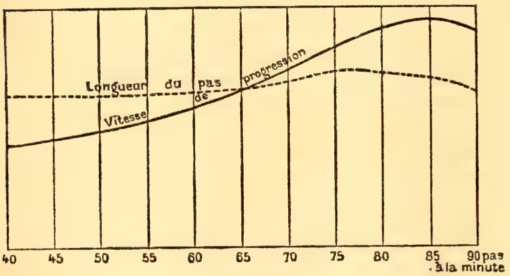


Fig. 5.

quickness of gait, and length of steps, as guided by the electric bell ringing at different rates.

Time of travelling over 1,542 metres.	Number of double steps to the minute.	Length of double steps.
20′ 30″	60	1.35 m.
18′ 40″	65	1.37 m.
16′ 27″	70	1.45 m.
14′ 58″	75	1.51 m.
13′ 52″	80	1.50 m.
13′ 3″	85	1.49 m.
14′ 1″	90	1.32 m.

NAVAL ARCHITECTURE IN ENGLAND.

Francis Elgar, professor of naval architecture at the University of Glasgow, devoted his inaugural address, on entering upon his duties in November, 1884, to a history of the science.

Until within comparatively few years but little attention has been paid to the study of naval architecture. Fifty years ago ninety-nine per cent of the British merchant-ships were under five hundred tons, and few measured more than a hundred and thirty feet. They were comparatively uniform; and, being built after an established plan, they were perfectly seaworthy when properly ballasted. In the case of war-ships the matter was more difficult; as it was necessary to get a type of ship which should be large, high out of water, and able to carry many large guns, without interfering with her sailing-qualities, or rendering her top-heavy.

In 1811 a school of naval architecture was started in England, and during twenty years it trained forty students. This was followed in 1848 by another at Portsmouth, and in 1864 by a third at South Kensington, which is now united with the Royal naval college at Greenwich. Some excellent designers have been graduated from these three schools.

Before the use of iron, ship-building required no elaborate calculations: it was simply a highly developed mechanical art. Ships were built of great relative depths in proportion to their breadth, and initial stability was deliberately sacrificed to reduce the tonnage measurement. Usually these ships would not stand up, when fully rigged and light, without ballast; and, judging from the proportions given to them, they must also have required ballast when laden with cargoes which were not composed of heavy dead-weight. What is now required of the ship-builder is to predict with great accuracy the weights of complicated iron and steel structures, with all their fittings and machinery; the weight of cargo that such structures will carry at sea; the stability they will possess in different conditions of loading, and the treatment necessary to insure a safe amount of stability being preserved upon all occasions; the amount of steam-power and the rate of coal-consumption required to maintain given speeds at sea; and very frequently the strength that is possessed by the hull to resist the straining-action of waves.

The reason that the English schools for this study have not been better attended, is that the courses are too technical in character, and the requirements too rigid, to attract any except advanced students. The idea of the newly established chair of naval architecture in the University of Glasgow is to teach in a less technical manner the new science, and to adapt the course to the requirements of the students. The policy will be first to fix what they already know, and then to go forward to a complete study. Special stress is to be laid upon long-continued and arduous practical training, combined with true science. The only way in which superiority in ship-building can be attained is by possessing a class of ship-builders who have gone through just such a training, and who by long study and work have acquired these theoretical and practical principles.

RECENT BRITISH LOCOMOTIVES.

Engines recently designed for the London, Brighton, and south-coast railway of Great Britain by Mr. Stroudley, were described by their designer at a recent meeting of the British institution of civil engineers. They were designed for freight-traffic, or as

goods-engines.' The steam-cylinders were inside the frames. The forward wheels were coupled, instead of, as usual, the after-wheels; thus getting a set of small trailing-wheels, short outside coupling-rods, and a large boiler. The centre of gravity of the engine was purposely made high, as is the practice in this country in the construction of the wide-firebox engines of Mr. Wooten, for the purpose of making the engine move more easily at high speeds, and, as both these designers believe, making them safer; the rolling being less serious at exceptionally high speeds than in engines having a low centre of gravity. The action of the high centre of gravity in throwing the pressure mainly upon the outer rail, in rounding curves, was thought to be another advantage of appreciable value, permitting the inside wheels to slip more readily. Six wheels were used, without truck or 'bogie.'

It was asserted that the cranked axle, and other parts of the machine, do not break if properly proportioned, although it was evidently felt that the axle is a source of danger in greater degree than when straight, as in outside-connected engines. The steam was given an admission varying from twelve to seventy-eight per cent, the engine running very smoothly, and with great economy, at high speeds, with the shorter cut-off. The compression is thus made advantageous in both ways. It was considered that compounding would not be of sufficient advantage to justify its adoption in such engines; although it might prove useful for heavy, slow-moving engines, working with little expansion the greater part of the time. The Westinghouse brake was fitted to all these engines, and gave thorough satisfaction. Its pump had been fitted with a water-connection, and it could thus be utilized as a boiler-feeder when on sidings. The boiler was made of Yorkshire iron, with joints butted, edges of sheets planed, holes drilled after bending the sheets, and all hand-riveted. The steam used amounted to about twenty-six pounds per horsepower per hour, on a road on which the average is thirty. One pound of coal conveyed one ton thirteen miles and a half, at the speed of 43.38 miles an hour. Heating the feed-water saved two pounds and a half per train-mile.

SEMI-CENTENNIAL OF THE LYCEUM OF NATURAL HISTORY AT WILLIAMS COLLEGE.

IT will be news to many, that a natural history society of college students has had an uninterrupted existence of fifty years at Williams college, in the little village of Williamstown, Mass. It is nevertheless true, and its semi-centennial was celebrated on April 24.

The exercises were opened by the president of the society, Mr. Henry B. Ward, with a short historical sketch. "Fifty years ago," said he, "on the 2d of April, eight students of Williams college formed a society for the study of natural history in its various departments. At first secret, under the name of Φ_Β Θ, within six months it adopted its present name. Professor Albert Hopkins, speaking twenty years later, said that it had sustained from the beginning a spirit of enterprise. The history of its early years remarkably verifies his assertion; for within a year from its formation it was large and active enough to send to Nova Scotia an expedition of twelve members and three professors. This expedition gave the lyceum a considerable reputation, and it was referred to by a French scientific journal as the first of the kind attempted in America. In the spring of 1840, only four years later, an expedition was sent through Berkshire county for study and collecting. By these two expeditions and individual effort, the collections well filled the society's rooms in East college. When that building was destroyed by fire, in 1841, the collections also perished. Contributions from all sides, and hard work by the members, soon restored them so well that the rooms in South college became too small; and in December, 1854 a circular was sent out, forcibly setting forth the needs of the lyceum, and asking for twenty-five hundred dollars to erect a building. This circular was brought to the notice of Mr. Nathan Jackson of New York, a relative of Col. Williams, and grand-uncle of the president of the lyceum at that time. He sent a check for the whole amount; and in a few months Jackson hall was completed. At commencement, Aug. 14, 1855, the lyceum was addressed in the forenoon by Prof. William B. Rogers, and in the afternoon held a public meeting in its new rooms in Jackson hall, to dedicate the building, and celebrate its twentieth anniversary. At this time Mr. Jackson sent a thousand dollars to make up the full cost of the building. In February, 1857, desiring to fill the cases in Jackson hall, the lyceum sent an expedition to Florida. Sixteen members, under the guidance of Professor Chadbourne, spent a month collecting on the Florida shores, with great success. The expenses were provided for by the liberality of Mr. Jackson and other friends of the society. In 1860 another expedition under the charge of Professor Chadbourne was arranged to Labrador and Greenland, a description of which has been recently published by Prof. A. S. Packard, a guest of the lyceum on that trip. In 1867 an expedition under the joint auspices of the lyceum and the college was sent to South America, under the charge of Professor James Orton, a former president of the lyceum. A small party proceeded from the northern coast by the courses of the Orinoco and Rio Negro to the Amazon: the main body crossed the Andes from the western coast, and descended the Amazon in canoes. In 1870 an expedition from both the lyceum and college spent four months collecting in Central America with great success. The expedition of 1877 to the northern Rocky Mountains was broken up by the death of Professor Tenney, its leader, just as it had started.

"Many have been the professors who have aided the lyceum in its work; but to Professor Albert Hopkins, Dr. Chadbourne, and Professor Tenney it owes a debt of gratitude which can never be computed."

Dr. W. K. Brooks, a former president, then addressed the lyceum on Life. He spoke of the age

of biology, the study of life, and said that modern biological study began with Darwin's visit to the Galapagos Islands fifty years ago. "Activity of protoplasm cannot be called life. Vital phenomena are distinguished by what is done, not by the constituents of the organism. There is no necessary connection between life and protoplasm. The common characteristic in all life is education. Life is education, and education is life. Kick a stone and a dog: the difference in the result is caused by education." He then referred to examples of natural difference in life as caused by education, and adjustment by education to varied circumstances. "The common characteristic in all these forms of life, from the highest to the lowest, is education. If, then, life is education, in seeking the latter we are advancing the former."

At the close of the lecture, Dr. Brooks was tendered a reception by the lyceum, at its building, Jackson hall, where letters and speeches from old members showed that their interest was still great.

The lyceum is the only active college society in this country which has its own building. It has now about twenty working-members, and holds its meetings every week, at which reports are given by members appointed in advance, on the subject which they are studying. Since Dr. S. F. Clarke took the professorship of natural history in the college, a strong interest in biology has been aroused in the society.

Among the members who have devoted themselves to science after graduation, the following are the best known: Professor Addison Ballard, '42; Mr. William H. Edwards, '42; Prof. W. D. Whitney, '45; Hon. D. A. Wells, '47; Dr. P. A. Chadbourne, '48; Dr. William Goodell, '51; Prof. Henry A. Ward, '55; Professor James Orton, '55; Mr. Samuel H. Scudder, '57; Dr. R. H. Ward, '58; Dr. E. W. Morley, '60; Prof. F. H. Snow, '62; Dr. G. Stanley Hall, '67; Dr. W. K. Brooks, '70; Dr. E. A. Birge, '73; and Mr. J. S. Kingsley, '75.

THE UNITED STATES AT THE FISHERIES EXHIBITION.

It is impossible to do much more than indicate the contents of this immense volume of over thirteen hundred pages. It is entitled 'Descriptive catalogues;' but, as observed by Mr. Goode, it really partakes of the character of a report on the part played by the United-States exhibit at the London fisheries exhibition, — not only that of the government, but also that due to private American exhibiters. A considerable part of the volume was printed, and distributed to visitors, during the exhibition.

There is a short introduction by the commissioner, followed by some data from the census; a list of forty-two gold, fifty-five silver, and thirty bronze medallists; beside some fifty other awards to American exhibiters, followed by a report on the collective exhibits of the U. S. national museum and the U. S. fish-commission. It is needless to say that every branch of the subject is thoroughly presented, either by specimens, models, illustrations, or literature. There is included under these a useful series of catalogues by Messrs. Rathbun (Economic invertebrates, except mollusks), Ridgway (Water-birds), Winslow (Economic mollusks), Brown (Whale-fishery), Bean (Fishes, and illustrations of fishes), Rathbun (Scientific appliances for deep-sea investigation), True (Aquatic mammals), Capt. Collins (Vessels and boats), Earll (Fishing-tackle and appliances), Clark (Fishery products), and Earll (Fish-culture).

The catalogues of birds and fishes are of particular interest and value, apart from their present connection, to all interested in those departments of biology. The catalogues of mollusks and other invertebrates are necessarily much less complete, and are expanded and improved from the centennial catalogues of Messrs. Dall and Rathbun, prepared for Philadelphia.

The volume is a monument of well-systematized labor, but would probably have been more convenient for reference if it had been divided into two volumes. The anthropologist, ornithologist, ichthyologist, fisherman, or manufacturer can hardly fail to find useful and welcome information in these pages; while, by the staff of the commission and museum, the book can hardly be contemplated without a feeling of thankfulness that the period of extraordinary drudgery, apart from their usual and regular duties, which the volume commemorates, is at last entirely over.

Report upon the exhibit of the fisheries and fish-culture of the United States, made at the London fisheries exhibition, 1883. Prepared under the direction of G. BROWN GOODE. (U. S. nat. mus., bull. 27.) Washington, *Government,* 1884 [1885]. 8°.

PHYSICS OF THE EARTH.

This is an admirable book. Dr. Günther, whose thoroughness has been well shown in his earlier writings, makes many physicists, mathematicians, and geographers his debtors by preparing so able a work on the subjects where they meet on common ground; and, if all teachers of physical geography and geology had the good fortune to possess the advanced training that this volume gives and requires, we should hear less from the classical men of the insufficient discipline afforded to the scholars in our secondary schools by their natural-his-

Lehrbuch der geophysik und physikalischen geographie. Von SIEGMUND GÜNTHER. Band i. Stuttgart, *Enke,* 1884. 10+418 p. 8°.

tory studies. A second volume is promised to contain the more geographic topics, while the one now issued treats of terrestrial physics in a more general sense under such headings as the relations of the earth to the other planets, the form of the earth, the effect of its motion, and the condition of its interior. These are preceded by an historical introduction, and followed by a brief and discriminating discussion of volcanoes and earthquakes; and all the chapters are closed by extended lists of citations that add greatly to their value. As indicative of the careful and learned investigation that has been required in the preparation of the work, we cannot do better than give in brief abstract an outline of three discussions on subjects that have not received sufficient attention on this side of the water,— the irregularities of the earth's shape, the effects of its rotary motion, and the hypothesis that its interior is gaseous.

The development of the belief in the globular form of the earth is treated at length; and the reasons for giving up the Cassinian view of its elongated polar diameter and accepting the Newtonian explanation of its polar flattening are clearly stated before mention is made of the difficulties that have been encountered in attempting to reconcile the accurate arc-measurements of modern times with the supposition that the earth must have a regular form. It is then shown, that after it had to be admitted that meridians measured in different countries could not be fitted on any single ellipsoid, and after it was found that mountains exerted a sensible lateral attraction on plumb-lines hung at their bases, it was still supposed, even by such men as Gauss and Bessel, that the ocean was essentially level, and that it would serve as a proper fundamental surface to which measurements of altitude, or distance from the earth's centre, could be referred. During the prevalence of this opinion, through the first third of this century, careful observations of swinging pendulums were made in many parts of the world; for, as the pendulum moves in obedience to gravity, the flattening of the earth could be deduced, it was thought, from the number of oscillations counted in a day at different latitudes. In the course of these difficult experiments, it was found, strangely enough, that pendulums would swing faster on mid-oceanic islands than on the opposite continental coasts: the difference was small, only eight or nine seconds a day; but it was persistent, and, as it implied a greater strength of gravity, it soon led to the conclusion that the earth was denser beneath the oceans than below the continents. This view is now widely quoted, and it probably will long remain in our text-books; although there can be little doubt that it is quite incorrect, and that the true explanation of the difficulty is to be found in the deformation of the ocean's surface by lateral continental attraction. The most important investigation of this deformity, and of the many difficulties it adds to geodetic work, is by Fischer, in a small volume entitled 'Untersuchungen über die gestalt der erde' (1868). Saigey, Stokes, and Hann have also considered the question; and, although it is not yet possible to say how much the sea is drawn up on the flanks of the continental masses, it is sufficiently demonstrated that the lifting amounts to many hundred feet on certain coasts. As a result, islands appear in mid-ocean that would be submerged if the ocean's surface were really level; and pendulums must naturally swing faster there than on the coasts, because they are nearer the centre of the earth.

Other important modifications of previous views follow from these conclusions; continental upheaval becomes more of a problem than ever; the great East-Indian arc is considered useless for determining the size and shape of the earth; and Airy's explanation of the absence of lateral attraction by the Himalaya is pronounced incorrect. Evidently, geodesists have still much to do.

Among the consequences of the earth's rotation, Günther gives a full and precise account of the lateral deflection of horizontal motions so conspicuously seen in the oblique motion of the trade-winds. There is not to be found an English text-book on physical geography in which this matter is properly explained: when mentioned, it is almost invariably stated that the deflective force acts only on north or south motions, and is nothing on bodies moving east or west. Even Herschel has explicitly given this meaning. But as a matter of fact, the deflective force is the same, whatever be the direction of motion from a given point, and the demonstration of this unapparent truth is here simply presented. Still a farther step is taken in quoting the results of Finger's recent investigations, where it is shown that on a spheroid, instead of on a sphere, it is not precisely true that the deflective force is independent of the direction of motion: it is greatest for eastward motion; and in confirmation of this, Günther quotes Darapsky, who finds that in artillery practice the observed deflections are greatest when the aim is directly to the east. The variation is extremely small, and

is only apparent in high velocities. For nearly all studies, it will suffice to consider the deflections as if produced on a sphere.

Ritter's speculations concerning the gaseous condition of the earth's interior are of especial importance, inasmuch as they may tend to counteract the very positive statements made by English physicists and geologists in recent years in regard to the age and contraction of the earth as determined by its cooling. The English school generally regards the earth as essentially solid, with a great central volume of dense matter at a high, and, roughly speaking, uniform temperature. On the basis of certain plausible assumptions concerning the original temperature and conductive power of the mass, it has been possible to approximate fairly well to the age for an earth of such characters, and to determine roughly the shortening of its radius, and consequent diminution of circumference since it has had a definite solid crust on which water might condense from the vaporous atmosphere into the oceans. The age of an earth thus limited has greatly reduced the estimates in vogue by the followers of Hutton and Lyell, even though its years are still to be counted by millions. Its contraction from cooling has also been pronounced insufficient to produce the observed structure of mountain ranges in the way that Élie de Beaumont had suggested. Strongly contrasted with these assumptions and their legitimate results are the conclusions reached by Ritter. His original papers were published in Poggendorff's 'Annalen,' and have received an approving review from so trustworthy a physicist as Zöppritz. Günther quotes largely from the latter. We cannot here do justice to the hypothesis, for it would need a somewhat deliberate statement to make it clear. Excessively dense vapors, probably dissociated from their ordinary combinations, and existing at temperatures high above their 'critical point,' are supposed to occupy the earth's centre; and from these there is a gradual transition to the solid superficial crust. The cooling of such a central mass follows a paradoxical law, — the more heat it loses, the hotter it becomes, — and so the supply of interior heat is long maintained, and the time allowed for geological processes is lengthened. Moreover, the contractional theory here finds a cause for all the diminution of interior volume demanded by the wrinkling of the crust in mountain ranges. Altogether, while the venturesome hypothesis is very far indeed from any thing like demonstration, its consideration is profitable if it prevent our settling down prematurely to a fixed belief concerning the condition of the earth's interior.

We shall wait impatiently for the second volume of the work, in which the physics of the air and sea will be discussed; and it will be particularly interesting to see what treatment so learned an author gives to the physical geography of the land.

ROMANES' RESEARCHES ON PRIMITIVE NERVOUS SYSTEMS.

ALL who are interested in the physiology of the nervous system in lower animals will find in this volume a most useful popular contribution to this subject. The book, as the author states, is restricted to experiments made in his own researches; but these are so numerous and varied that it will be found to contain a summary of the most important results in this line of investigation which are at present known.

'Do they feel?' and 'Have they senses?' are questions which are very naturally asked by any one who watches the varied movements of the jelly-fishes, star-fishes, and sea-urchins. A natural credulity prompts one to question whether the medusae, whose bodies contain over ninety-eight per cent of water, have a nervous system, and organs of special sensation. Twenty-five years ago, science would have given a very unsatisfactory answer to these questions; but to-day we have a very accurate knowledge of the anatomy of these structures. With this advance in anatomical knowledge, physiological research has kept pace; and certainly no one has done more than Romanes in this kind of research. Thanks to these advances, we can now reply to our questioner with more confidence than formerly. These animals not only feel, but also have special organs of sight, hearing, and probably smell.

The author puts the anti-vivisectionists in a receptive frame of mind for the work which follows by declaring, in the introduction, that his experiments on living animals involve no pain, and that the "consciousness which is present must be of a commensurately dim and unsuffering kind."

The work is mainly taken up by experiments in excising portions of the body, and noting the effects on the movements of the animal. Many very interesting experiments

Jelly-fish, star-fish, and sea-urchins: being a research on primitive nervous systems. By G. J. ROMANES. New York, *Appleton,* 1885. (International scientific series.) 12+323 p., illustr. 8°.

on the effects of the application of stimulants — mechanical, electrical, and chemical — are described. The action of poisons upon jelly-fishes shows a wonderful resemblance to that of the same on higher animals. Many conclusive experiments are given to prove that the fatal effects of transferring medusae from salt to fresh water is not due to a difference in density of the two media. A medusa artificially frozen into a solid block of ice, so that ice-crystals are formed in its body, is not killed by the operation.

The observations on the star-fishes and sea-urchins are recorded in a single chapter; yet they are in many respects as interesting as those on the jelly-fishes in the preceding nine chapters. The author points out the different methods adopted by star-fishes and sea-urchins in righting themselves when turned upon their backs. The 'geometrical regularity' of these animals, in their nervous system as in their form, leads to a "very pretty instance in physiology of the physical principle of the parallelogram of forces." If two stimuli are applied simultaneously at opposite extremities of an axis passing horizontally through a round sea-urchin, the Echinus moves off 'in a direction at right angles' to a line connecting these points.

The author finds, that, by cutting off the eye-spots from several star-fishes and sea-urchins, they do not seek the light thrown into the dish, as is invariably their habit when these organs are intact. He also finds that an excised ray of a star-fish makes its way to the beam of light as if it were an entire animal. A star-fish, with all the eye-spots but one removed, crawls to the light.

Romanes ascribes to the star-fish a sense of smell from the following experiments: a star-fish is kept fasting for several days. A piece of shell-fish is then placed in the tank with the animal. He immediately crawled toward it. "Moreover," says the author, "if a small piece of the food were held in a pair of forceps, and gently withdrawn as the star-fish approached it, the animal could be led about the floor of the tank in any direction, just as a hungry dog could be led about by continually withdrawing from his nose a piece of meat as he continually follows it up." To determine the region of the body where the supposed sense of smell is located, the experimenter removed the eye-spots, and the hungry star-fish moved in the direction of its food. He varnished the whole upper (aboral) surface of the body, and still the acuteness of the sense was not diminished. He concludes that the sense is not localized, except that it is "distributed over the whole of the ventral or lower surface of the animal."

These last-mentioned experiments can be easily tested by any one without elaborate apparatus. Certainly one great value of all the experiments is their great simplicity; and the book has this strong recommendation to contribute to make it, what the author expresses a wish that it should be, a "book of service to the working physiologist."

The work of Romanes is certainly one of the most valuable contributions to the physiology of the primitive nervous system which have been published, and it is the only book on this subject which has yet appeared in America. Yet, much as there is to praise in this book, there are several statements which an anatomist cannot accept; but these do not detract from the excellence of the work, as far as the main questions are concerned.

MINOR BOOK NOTICES.

PROFESSOR JOHNSON'S little book on curve-tracing is more clearly arranged than Frost's treatise, and seems much better suited to the wants of readers who need only a general knowledge of methods, and do not wish to go into refinements of approximation which they may seldom or never have occasion to use. Students rarely think it worth while to spend much time in curve-tracing after they have once acquired a little knowledge of analytic geometry; but every man who means to devote his attention specially to mathematics needs to have some facility in interpreting equations geometrically, and this he can best get by studying some such book as the present one. Professor Johnson treats the analytical triangle in a way which will recommend itself, we feel sure, to mathematicians, and introduces it so early that a person who has time for no more can read the first half of the book to advantage. In a few instances the addition of a short clause would make clear sentences which are now rather obscure.

Pettit's little book gives in a concise form a brief account of nearly all the more important

Curve-tracing in cartesian co-ordinates. By WILLIAM WOOLSEY JOHNSON, professor of mathematics at the U. S. naval academy. New York, *Wiley*, 1884. 6+86 p. 16°.

Modern reproductive graphic processes. JAMES S. PETTIT. New York, *Van Nostrand*, 1884. (Van Nostrand sc. ser., No. 76.) 4+127 p. 16°.

Comparative physiology and psychology. A discussion of the evolution and relations of the mind and body of man and animals. By S. V. CLEVENGER, M.D. Chicago, *Jansen, McClurg, & Co.*, 1885. 6+247+10 p. 8°.

Elements of zoölogy. By C. F. HOLDER and J. B. HOLDER, M.D. New York, *Appleton*, 1884. (Appleton's sc. text-books.) 10+385 p., illustr. 8°.

modern methods of illustration. Its purpose is to give a general popular knowledge of these processes, rather than to give those explicit directions which would enable one to carry them out in practice. In one or two places the description is not quite clear, as in the account of Mr. Eckstein's process, on p. 45. Again: under 'Instantaneous photography,' the statement of some of the optical phenomena is incorrect. But, with these trifling exceptions, the book is an admirable one, and well adapted, in connection with a course of lectures, to serve as a text-book in our colleges and high schools.

In the preface to Clevenger's 'Comparative physiology,' the author states that "Faraday, Huxley, and Tyndall, in chemistry, biology, and physics, with the host of workers in nerve phenomena, have afforded the materials for the author's work. Darwin and Spencer have taught him how to make use of them." The book shows that the writer reads widely, and thinks about what he reads. But to publish the quotations which have impressed one, with the ideas they have awakened, even if those ideas are apt and original, is hardly wise. The work contains some careful observations which have a bearing upon the doctrine of evolution; but these are presented in such a fragmentary way, and in such an anxiously defensive tone, that it is difficult to appreciate their force. The defect in the book is owing to a lack of power of analysis and synthesis. It has no method of arrangement, and it has no easy grouping of analogous fact. Some pages read like a series of proverbs, each one complete, but out of relation to all the rest (pp. 125–129): hence it is difficult to become interested, as the attention is not held. If one has worked out a system of philosophy which reconciles all the facts of physiology and psychology, it should be carefully digested and arranged before being placed before the world, and then its acceptance will largely depend upon a style which attracts, and a confident power of persuasion which convinces.

The plan laid down by the Holders in the preface to their 'Elements of zoölogy' is excellent. Each branch, class, and order is to be plainly defined, and its difference from preceding ones shown. Available examples are to be chosen, and the student encouraged to personal investigation. The specimens described are, as far as possible, available. But the first promise is almost entirely disregarded. Indeed, the author seems to have such a fear of classification, that the book is a mass of facts, without any apparent system of arrangement. The descriptions of the lower invertebrate classes are so meagre and unsatisfactory, that it is sometimes impossible to tell exactly what group is intended without reference to the heading of the section, or to the cuts, which are generally excellent. Much less could the average student take any given normal specimen, and, by reference to the text, locate it in its proper class, and find there a clear description of its anatomical structure. Why do nearly all our elementary text-books devote from a third to a fourth of their space to mammals and birds, to the neglect of more available, but rather less familiar groups (e.g., insects), which would furnish an inexhaustible mine of material easily accessible to the student's investigation? The notes on the economic importance of different groups form a new and interesting feature; and the bibliography is excellent, in referring almost altogether to works which should be within reach of every teacher and student.

NOTES AND NEWS.

IT IS announced that a serious revolt against the Turkish power has arisen in Morocco. Six provinces, or confederated bodies of population, are implicated. The situation is grave, though such matters are not rapidly disposed of in that country. Practically, all that part between the 6th and 7th degrees of west longitude from Paris is to-day independent of the sultan; and the Berâber, indomitable and ferocious, have, both in the north and south, revolted against an authority to which, by the way, they were never entirely submissive. Part of this tribe are mountaineers, like the Kabyles; the rest, equally fierce nomads. Together they can muster twenty or thirty thousand rifles in war-time. Morocco for a long time has contained three large regions which maintained their independence. In the quietest times, only about one-half the area denominated Morocco on the best maps has acknowledged the temporal authority of the sultan. The Berâber, moreover, are the clients and religious adherents of the princely family of Sheik Walad Sidi of Algeria, whose head, long resident in Paris, is now the declared enemy of France, and one of the foremost soldiers of the Sénousian confraternity. From these facts, it is evident that serious consequences might flow from the present disturbances.

—Serpa-Pinto writes from the Mozambique coast, at Port Bocage, that he is about to lead an important scientific expedition into equatorial Africa for Portugal. He will not visit the Kongo, as has been erroneously reported. He will be assisted in astronomical matters by Lieut. Cardozo and Paul Mapp (photographer), a hundred Zulus armed with modern rifles of the best kind, and four hundred porters. His mission is to study the country between the upper

Zambezi and the coast south of Lake Bangweolo, and it is to be of a purely scientific character.

— The German bark Ceylon reports that April 10, in latitude 31° north, longitude 71° west, she was struck by a water-spout, carrying away main and mizzen masts close to the deck, killing the first officer, and seriously injuring Capt. Newman. During the early part of the night, two distant thunder-storms crossed the sky. All sail was furled except reefed lower topsails. Near midnight a low cloud was observed about five degrees above the horizon. The remainder of the sky was clear. The ship was heading north-north-west, and a gentle breeze was blowing from south-west. Suddenly, through the darkness, something that at first seemed a ship was seen quite near, bearing west-north-west. Then all crouched to the deck, for a water-spout was close aboard. The wind struck the bow with hurricane force, while at the wheel aft it became a dead calm. The vessel was thrown over to starboard until the lower yard-arms almost touched the water. Her head was forced round from north-north-west to south-south-east, and the sails torn into ribbons. Then, as the wind came round to starboard, the vessel righted and went over to port, until the rail was under water in almost an instant. The main and mizzen masts were whipped out of her, and the men thrown across the deck, killing the mate. Then suddenly it became calm, and the vessel righted. The captain thinks it all occurred within two or three minutes. During the time they were in the influence of the water-spout, there was a great deal of St. Elmo's fire on all the ironwork of the vessel.

MAP OF OLD RIVER LAKES ALONG THE MISSISSIPPI RIVER.

— A brief paper by J. A. Ockerson of St. Louis, on the earlier floods of the lower Mississippi, in the Journal of the Association of engineering societies for January last, and a discussion of it by R. E. McMath, furnish some interesting statements about the great river. The conclusion is reached by the first-named author, that, on account of the relation that must exist between mean flood height and the altitude of the flood plain, it is possible to conclude from the equality of height of the actual and long-abandoned river-banks that there has been no perceptible change in the mean flood height for at least two centuries, and hence that the cutting-away of our forests has not yet had a perceptible effect in the *régime* of the river. The second author justly remarks that the exceptional floods may now be higher than formerly without significantly affecting the mean height of floods. The old river-banks alluded to are now seen enclosing the crescent-shaped lakes, so characteristic of rivers that shift their course in alluvial plains; and these are well illustrated in a plate, here copied in part (the main stream is left unshaded), constructed from manuscript maps of the government surveys of 1882 and 1883, of which we are glad to have even this small glimpse. Lake Bruin was cut off before the river was known to navigators; Lake St. Joseph was abandoned probably before 1700, and in the change the river-course was shortened twenty miles or more; Palmyra Lake was formed by the Davis cut-off in 1867; it is nineteen miles around, while the neck was less than a mile wide. The slope of the flood plain away from the immediate river-banks, caused by the quick deposit of much sediment near the main channel during overflows, is sometimes very marked. It generally gives a lateral descent of from one to ten feet in a mile, and in an extreme case the fall was 13 feet in 657. The bluffs enclosing the river-bottom are shown on the east, but are not included on the west.

— In the report of the International commission of the Suez Canal, says the *Electrical review*, attention is drawn to the important question of night navigation in the canal by means of the electric light. This subject is said to be under serious consideration, ex-

periments having been made with the electric light between Suez and Ismailia. But it happened, unfortunately, that a bright moon was shining on the night when these experiments were made, the result being that the effect of the electric light was lessened.

— Capt. W. H. Hill reports, that while on board the schooner Elizabeth, bound from New York to Newbern, N.C., he met with a heavy gale off Hatteras, wind north-east, heavy sea. He could not clear the Diamond, and had to scud through Hatteras Slough. The sea boarded the vessel, and took the bulwarks away. Fearing for the vessel's safety, oil was poured over the stern, a little at a time, from an ordinary stone jug. This at once smoothed the sea's surface, making it partake of the nature of a ground-swell; and the Elizabeth went in without shipping any more seas. A brig, seeing the smooth water astern of this vessel, steered for her wake, and ran through under close-reefed topsails, keeping in the smooth water.

— A summary of observations on earthquake phenomena made in Tasmania, during 1883 and 1884, by Commander Shortt of Hobart, records a great number of moderate shocks during these years, although they had been very rare before. Nearly one hundred disturbances were felt at St. Mary's in February, 1884; and over one thousand have been noted at Gould's Country since April 12, 1883, when the first shock was felt there. These small earthquakes are seldom felt outside of the north-eastern part of Tasmania; and their origin seems to be a hundred or more miles out to sea, near the border of the deep waters which separate Australia from New Zealand.

— The Linnean society of New South Wales again offers a prize of one hundred pounds for the best essay on the life-history of the bacillus of typhoid-fever. The essay must be based entirely on original research, the details of which, and of the methods employed, are to be fully explained; to be delivered before Dec. 31, 1885.

— Mr. C. R. Orcutt of San Diego, Cal., proposes to publish from that place a small quarterly journal devoted to the study of shells, crustacea, and radiates, in the interest of students and collectors of the same.

— The Board of trustees of Indiana university selected Prof. John M. Coulter of Wabash college, and editor of the *Botanical gazette*, to fill the chair of botany in that institution; but it is understood he has declined the position.

— In speaking of the erosion of big guns, Capt. Noble recently explained to a representative of the *Pall-mall budget* that the latest era in gun-making dated back to 1877. The great advance then made resulted directly from experiments with powder. We stepped at once from velocities of fifteen hundred feet to the present velocities of from two thousand feet to twenty-three hundred feet per second. The very high charges now employed (eight hundred and thirty pounds of powder have been fired in a single charge from a hundred-ton gun, and three hundred pounds from a gun not quite twenty-five tons in weight), and the relatively very long time during which the high pressure and the temperature of the explosion are continued, have aggravated to a very serious extent the evils due to erosion, and the consequent rapid wear of the bores of guns. At the moment of explosion the surfaces of the guns in the vicinity of the charge are in a state of fusion. The heated gases passing over these fused surfaces at a high velocity and pressure, absolutely remove that surface, and give rise to that erosion which is so serious an evil in guns where large charges are employed. All guns are now made with a lining, which is taken out when it has been eroded: the operation may occupy from two to three months. The hundred-and-ten gun could not be fired, with a full battering charge (nine hundred pounds of powder), more than a hundred and fifty rounds; but it will fire an almost indefinite number of smaller charges (say, two-thirds of the full charge) without very serious injury resulting.

— Messrs. J. de Brettes and P. Lacabanne-Courrège left Buenos Ayres in January with the intention of traversing the Grand Chaco at its greatest breadth from Corrientes to Candelaria. Persuaded that the misfortunes of previous explorers were due to the presence with them of a force so large as to excite the suspicions of the Indians, thus bringing on active hostilities, these travellers propose to make the journey, accompanied only by two Indian servants.

— Victor Giraud, having reached Paris on his return from central Africa, was received with *éclat* by a deputation from the Société de géographie; and it is announced, that, in recognition of the energy, perseverance, and courage with which he pursued his explorations, the Ministry of marine have proposed him for the cross of the Legion of honor.

— We have received three pamphlets by Dr. Rollin R. Gregg of Buffalo, entitled 'Diphtheria and bacteria,' 'Professor Pasteur's experiments, bacteria in various diseases,' and 'The revelations of fibrin.' They embody the results of the writer's so-called scientific experiments upon fibrine, of which material he finds all forms of bacteria to be composed. Inasmuch as he gives no reason to suppose that any proper methods of sterilization were employed, and displays his ignorance of the fact that distilled water may be full of micro-organisms, it does not seem possible that these papers will command much attention. Indeed, no such work is worthy of criticism; for the day has passed when the pathogenic properties of bacteria, as such, can be disputed, except as the result of the most careful labor by experts in all the methods of manipulation.

— In the article on 'Roads from India to central Asia,' in our last issue, in the third line of the third paragraph, second column of p. 361, 'northern' should read 'southern;' and in the first line of the fourth paragraph, in the same column, 'to the south' should read 'to the north.' In the next to the last line in the first column of the following page, '1883' should be '1881.'

SCIENCE.

FRIDAY, MAY 15, 1885.

COMMENT AND CRITICISM.

It may not be amiss to remind a correspondent in to-day's issue that the arguments which he uses to show the peculiar fitness of Col. Coleman for the position of commissioner of agriculture, would, with very slight changes, show him to be qualified to act as director of the geological survey, or superintendent of the census, or, in fact, for any executive position. The work of the department of agriculture is largely scientific work; and, as we had occasion to point out in the remarks to which our correspondent takes exception, the proper and effective direction of such work requires something more than ordinary executive and business ability. "The ability to distinguish and recommend what is best, to discover and make use of the ability of specialists," implies a thorough knowledge of what has already been done, and of the distinguishing qualities of the 'best,' an acquaintance with specialists, and a capability of judging of the merit of their work, such as only a 'technical expert' can possess. A man who, without special scientific attainments, undertakes to direct the work of scientific specialists, must inevitably stand much in the same position as the typical fine lady who is the slave of her domestics. He may irritate and hinder by ill-judged interference, or he may leave matters to take their own course, as has usually been done; but any broad, well-planned policy is practically out of the question.

A further important consideration is that there is a large and increasing number of agricultural colleges and experiment-stations devoted more or less exclusively to scientific investigations for the benefit of agriculture. The United-States department of agriculture should be the natural centre and regulator of this work, giving it a general unity, and preventing unnecessary duplication of experiments. Moreover, it is proposed to add to these, in the several states, so-called 'national experiment-stations,' in the conduct of which the commissioner of agriculture shall have at least an advisory power. It may be set down as certain, however, that the men who are conducting this experimental work, many of them eminent in their profession, will pay small heed to the advice of any commissioner whom they cannot respect as at least their equal in scientific attainments. We do not wish to be regarded as unfriendly to Col. Coleman. Judged by the previous history and present standing of the department, the appointment is an excellent one. What we desire to see is a new system, and only secondarily, and as a result of that, a new man.

Dr. Adolf Dronke, director of the real-gymnasium at Trier, has lately published an elaborate paper on the place of geography as a science and in the school. While certain parts of it seem to us somewhat visionary, — such as the formation of an international academy of geography, the establishment of professorships of geography in all universities, and the adoption of an initial meridian in 20° west longitude, — the greater share contains suggestions that are at least valuable and practical, even if not altogether novel. Certainly there is much need of improvement in geographic instruction, as we have already pointed out. There is so general an agreement on this subject, that what we need now is not so much a discussion of what changes to make, as how to get the money for making them. Good maps and models, illustrations and specimens, as well as expensively taught and far-travelled teachers, are the first needs, but where do we find school committees ready to supply them?

AMONG THE WONDERFUL achievements of modern explorers should be placed on record the history of the successful expedition of Capt. Willard Glazier in search of the ultimate source of the Mississippi River. This daring explorer, at the head of a large and well-equipped party, penetrated the untrodden wilderness of central Minnesota, and reached Lake Itasca, which has so long been regarded as the source of the great river. Not content with this achievement, he plunged boldly into the forest, and succeeded, after great exertions, in forcing his way three miles farther southward, where he came to a second lake, also drained by the Mississippi, and forming, as he states, its uttermost head. To this lake he gives his own name, that the fame of his achievement may be perpetuated. It is perhaps unfortunate, that, as this whole region was sectionized by the general land-office several years previously, lines having been run at every mile, a prior claim to this great discovery may arise. In any case, however, the names of Capt. Glazier and John Phenix as explorers will go down to posterity side by side.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The new commissioner of agriculture.

In your notice, April 10, of the appointment of Col Coleman to be commissioner of agriculture, you commend the selection because of his "knowledge of practical agriculture, and his experience of men and affairs," and indirectly condemn it because he does not have "any special or intimate acquaintance with the science of agriculture;" your idea seeming to be that the agricultural department should be organized as a 'scientific bureau, with a technical expert at its head.'

Col. Coleman has one additional qualification, in which he differs from all previous commissioners: he is without a pet hobby. His course will be to elevate the work of the bureau from the advocacy of some single theory, to the development of what is best in a variety of theories, and the adaptation of that best to the practical work of the agriculturist. To carry out such a course, it is not necessary that the head of the bureau should be a 'technical expert:' indeed, it is better that he should not be. Technical experts in one or two or three branches of scientific agriculture are, as a rule, those gentlemen who have bees in their bonnets, and seem to be incapable of such universal control as ought to be required; and experts in all branches cannot be found. If one have the ability to distinguish and recommend what is best, to discover and make use of the ability of specialists, to restrain the disposition in any one department of his general work to override or belittle the rest, that one is the person to have charge as the general head. Such a person is Col. Coleman. His experience of men and affairs, and the general appreciation of his fitness in the conditions you pointed out, by all classes of men, prove the wisdom of the selection.

When the bureau is to be properly organized as a scientific one, will be after the so-called agricultural colleges, founded at so enormous an expense by the general government, shall have done what they were intended to do, — raise up young men and women, first, to an appreciation of what scientific agriculture is capable; and, second, to an educational ability to pursue and apply it. Until the old ruts are abandoned by men capable of understanding the benefit of a new and well-made road, such men to be those who are practical workers themselves, there will be no use of attempting science in a place the province of which is really only the collation, selection, and diffusion of such knowledge as can be used in the gradual development of all the resources of the country. When the work of such an education is begun at the right end, it will have its natural sequence in a higher gradation of the work of the head of the agricultural bureau, if any thing higher than that which will be accomplished by the new commissioner is needed. AUG. F. HARVEY.

St. Louis, April 19.

Auroras.

Various speculations are met with from time to time as to the extent of any individual display of an aurora. A prominent French writer has recently attempted to show that auroras are not widely extended, and has instanced the case of the most brilliant aurora of modern times at Brussels, Belgium. This phenomenon occurred on Feb. 4, 1872; and the writer emphasizes the fact that it was not seen at Godthaab, Greenland. Meteorological observations at the latter place for this date are not accessible; but there is little doubt that, if there were such, it would be found that the sky was clouded, thus preventing the appearance. At all events, the observations made on the American polar steamer Polaris, which wintered about four hundred miles north of Godthaab, show the most brilliant aurora of the winter on Feb. 4. The same aurora was seen throughout the northern United States.

When we consider, that, as shown by Professor Loomis, during a maximum period of sunspots there are also the greatest number of auroras, and that great solar outbursts are followed or accompanied by magnetic storms and brilliant auroral phenomena, we are led to the view that the cause of the latter may be superterrestrial, acting either directly or indirectly through induced earth-currents.

It would seem as though all auroras are a manifestation of cosmic energy, and that their extent and brilliancy are limited by the amount of energy, by the vapor in the air, by the temperature, etc. Professor Lemström in Finland obtained a simulation of the aurora by artificial means during one winter; but during the next winter, which was barren of brilliant auroras, both he and Professor Tromholt, the latter in Iceland, failed in this. It may be that the first success was owing as much to earth-currents, or a condensation of atmospheric electricity, as to the artificial means employed.

The question of the source of the electricity of an aurora is an important one in meteorology; and

the fact that thus far all attempts at connecting auroral phenomena directly with meteorological have failed, goes far to show a cosmic rather than a terrestrial origin for the aurora. H. A. H.

An extinct hydroid.

Whether Shakspeare was the first to give expression to the idea of 'Sermons in stones,' the writer of this notice is not scholarly enough to answer. Strongly impressed by many demonstrations of its truth, it is in no spirit of detraction that he ventures the opinion that the inspired bard could not have appreciated the significance of his declaration, if we take into consideration what these sermons have since revealed to us of the past history of the world. The rocks have proved to be volumes of the most convincing sermons, and every pebble has a story that may be read. Such a pebble, the subject of the present communication, was sent to the writer by a greatly esteemed friend, the well-known naturalist and philologist, Prof. Samuel S. Haldeman, shortly before his death. It was picked up in Lebanon county, Penn., but exactly at what locality I failed to inquire. It is an irregular rectangular piece of quartzite, about an inch and a quarter in two diameters, and half an inch in the third diameter. It has several conchoidal fractures, is water-rolled, with rounded edges, and smooth. It is dirty white, opaque, homogeneous, and of flinty texture. Embedded in it, scattered here and there, are seen several dozen little fossils, all of the same character, and worn level with the smooth surfaces of the pebble. Most of the fossils have the form of a narrow ellipse with acute extremities, or have the shape of a section of a double convex lens. Where they cross the edges of the pebble, they exhibit the same form of outline on the contiguous surfaces; so that, if isolated, they would appear to be actually lenticular in form. They are composed of smoky-colored quartzite, cross-barred with white, and contrast conspicuously with their matrix. My first impression, on seeing the pebble, was, that the fossils were rhizopods, related to the nummulites; but an inspection with a lens indicated them probably to be hydroids related to the graptolites, and especially to Phyllograptus. The lenticular sections of the fossils generally range from four to nine millimetres in length by one to one and three-eighths millimetres in thickness at the middle. As represented in the accompanying figure, the white bars crossing the short diameter of the lenticular sections are produced by what appear to be two rows of cells, with their bottoms applied together inwardly, and separated by a median, slightly undulating line. Many of the cells are flask-shaped, with the neck directed outward, and reaching the convex surface of the fossil. In others the neck is variably shorter, and in some appears to be absent, the difference apparently being dependent on sections of the cells at different levels. In the specimen figured, the beaked cells appear somewhat curved or retort-like, but in other specimens they are straight. The body of the cells mostly exhibits a nucleus of smoky hue, while the walls of the cells are white, though not sharply defined from the nucleus. The appearance seems to be due to the interior of the cells being occupied by a more translucent deposit of silex. In several of the fossils like the one figured, the number of cells in each row is about two dozen. The lenticular sections of the fossils are not all equally symmetrical with the one figured, some bulging more on one side than the other, and a few being thicker towards one pole than the other, and less acute at the end. Two specimens, of which one is eleven millimetres long, are slightly constricted near the middle, and look like conjoined pairs. Another specimen, unlike the others, extends across the pebble for about eighteen millimetres, is of nearly uniform width throughout, and is broken near the middle. One extremity curves laterally, and ends in an obtusely rounded manner: the other extremity extends obliquely in an opposite direction, tapers a short distance, and is then prolonged to a broken end.

HALDEMANA PRIMAEVA.

From the well-known graptolites of the Silurian rocks, our fossil differs especially in the cells being embedded in a common basis or matrix, in this respect resembling such polyzoa as Cristatella in comparison with Plumatella. The age of the fossil I am unable to read in the pebble, though doubtless others may be able to do so. In Lebanon county the prevailing rocks are of lower Silurian age; and it is probable the pebble pertains to one of these, though it may have travelled from another source. The character of the fossil appears to be different from any previously indicated; and I would propose to name it Haldemana primaeva, in memory of the one who called our attention to this interesting representative of the hydroids. Joseph Leidy.

Phosphatic rocks of Florida.

In my 'Report on cotton-production in Florida,' vol. vi. of the quarto series of census reports, p. 14 (194), there is an analysis, by Dr. G. W. Hawes, of a building-stone from Hawthorne, Alachua county. This rock contains 16.02% of phosphoric acid; and it was considered as of eocene or oligocene age, like the rest of the limestone of the peninsula.

During the past winter, Mr. L. C. Johnson of the U. S. geological survey has been collecting in Florida, and has made a very important discovery. He finds that the building or chimney rock in several of the counties of the state, and probably wherever it is found, like that occurring at Hawthorne, is generally phosphatic. Specimens sent to me for examination by Mr. Johnson, from Suwannee, Levy, Alachua, and Marion counties, are strongly phosphatic, varying in content of phosphoric acid from five to ten per cent. The material which contains most phosphoric acid is a porous, soft rock, consisting in the main of grains of quartz, with occasionally a little carbonate of lime, but seldom very much. In some of the specimens, especially those from near Waldo, the soft friable rock contains small nodular masses of nearly pure phosphate of lime disseminated through it. The largest of these nodules is some two inches in diameter.

By the discovery of a highly fossiliferous bed near Waldo, Mr. Johnson has been able to fix the age of these phosphatic rocks as miocene or later; and this view is confirmed by the specimens from Rock Spring in Orange county, collected by me in 1880, which Professor Angelo Heilprin determined from the fossils to be miocene. I have recently tested all these specimens, and find them, without exception, highly phosphatic.

From these facts, and others presented in the subjoined letter of Mr. Johnson, it appears that the deposits of miocene age are generally spread over the Florida peninsula, if indeed they are not co-extensive with those of the oligocene.

This will lead to a modification of some of the views advanced in my census report above referred to, concerning the past geological history of the peninsula, and the origin of the high hummocks; for these hummocks, in part at least, are produced by the action of the *miocene* phosphatic limestone, and not the *oligocene*, upon the prevailing sandy soils.

And, similarly, the much wider distribution of these miocene rocks proves that a much larger proportion of the peninsula was submerged after the oligocene period than I at one time supposed.

We shall look with the very greatest interest for the results of Mr. Johnson's investigations of the rocks of the western coast of Florida, in Hernando and Hillsborough counties.

I may add that none of the specimens of the upper oligocene or Vicksburg limestone, either from Florida or Alabama, which I have examined, show more than a slight trace of phosphoric acid.

EUGENE A. SMITH.

University of Alabama, April 20.

It might have been hasty, without books, and without sufficient opportunity for comparison, to have pronounced the phosphatic rocks of Preston's Sink, Fort Harlee, miocene, or not older. I now think it later still; but always with the reservation that I may be permitted to change my mind upon a more careful study, under circumstances more favorable, and also deferring to the opinion of Dr. White, who already has such favorable opportunities, when he can get time to take up the subject, with all my collection before him.

The location of these phosphates is of more immediate import to you and me. But, on the question of the horizon, I ask the consideration of the facts and specimen already sent you. The 'Nigger Sink' at Downing's, in this vicinity alone, ought to set the question at rest.[1] There you find *in situ*, and exhibiting their due relations, the oligocene limestone at the base, and finally, after various intermediate deposits, a hundred and fifty feet above, the siliceous phosphatic rock, exactly similar to that sent you from the quarry at Gainesville, from Liveoak, and which is found in this oak and hickory region on the top of every hill.

There, also, you find two fossils,— the Ostrea, found also at Hawthorne and in the Wacahootie region, Marion county, always underlying the phosphates, and above the Orbitoides and Pecten of the limestone; and the other, the great coralline, of which I could mail but a fragment. This last is seen *in situ*, so far as I am now informed, nowhere but on the tops of these hills, overlooking the Natural Bridge of Santa Fé.

The Fort Harlee marl, near Waldo, is quite different from the phosphatic rock I have been sending you from so many points. It has all its shells, or casts of shells, intact. The vertebrate fossils, however, seem the same; that is, the sharks' teeth and saurian remains are alike. The phosphatic rock has lost all its fossil shells. That these once existed, is clear from the fact that occasionally a trace may be found. If not the same, then how are they related? The argument must be postponed; but to me the conclusion is clear that the Waldo bed is newer than the others. All the others, from the texture of the rock, the obscure traces of shells, the chemical constituents, and from the surroundings, may be classed as one. The great extent of the formation, and the uniformity of the rock, are still very remarkable.

Undoubtedly it is the same rock seen near Ocala, where the limestone is not visible, at Hawthorne, at Gainesville, at Newmanville, at two or three knolls in the vicinity of Liveoak, and on innumerable others all over this central region of oligocene sinks. Strangely, too, the knobs are uniformly of a height of about sixty feet above the surrounding flats and depressions marked by the cherty limestone. It would be interesting and valuable, if I had the means in my power, to locate and measure the extent of every one of these deposits. Your own census report, giving the extent of hummocks, and oak and hickory soils, east of the great chain of sand-dunes from Apopka northward, and west of the lake region, is the nearest means I can suggest for making an approximate estimate.

LAURENCE C. JOHNSON.

Newmanville, Fla., March 22.

[1] Three others, heretofore explained, — Simmons at Hawthorne, Sullivan old field, and the devil's mill-hopper, — sustain the same conclusions, and none contradict.

Do telegraph-wires foretell storms?

Probably some thousand Americans have noticed the automatic storm-signalling of wires by sound-vibration. I allowed a telephone-wire to remain for a long time attached to one corner of my (frame) house because of its practical utility as a weather-prophet. When not a leaf was stirring in the neighborhood, and not a breath to be felt, the deep undulations were audible in almost every room, although mufflers had been duly applied. Before that, some hours in advance of every severe storm, the upper story was hardly inhabitable on account of the unearthly uproar, which would have made a first-rate case for the Society for psychical research.

The warning that it gave varied from six to twelve hours, rarely exceeding the latter; and I do not think it ever warned in vain. When the storm actually came, the noise nearly always ceased. It never was noticeable in the warmer part of the year; and through the heat of midsummer it was silent. I cannot recall any exception to this. Its climax of clamor was reached some hours before the 'electric storm,' as it was called, of November, 1882. But all through two winters and the proximate parts of autumn and spring I found it a trustworthy and self-announcing storm-signaller, which left me abundant time to prepare. I had it removed, finally, because there was sickness in the house, and its doleful prophecies were not appreciated.

I explained the phenomenon, partly at least, by the effect of very distant air-impulses transmitted in sound-waves from wire to wire, after the manner of the acoustic or mechanical telephone. Yet this does not seem quite adequate, when one considers how far those vibrations must have travelled to outstrip a storm by hours; and yet how much energy and sonorousness they retained when they reached me!

WM. H. BABCOCK.

Washington, April 16.

[We have good authority for saying that the vibrations of the telephone and telegraph wires here referred to are certainly not due to electric currents, nor to the minute acoustic waves of the mechanical telephone, but are simple transverse vibrations and longitudinal waves such as occur on every stretched cord that gives out a musical note. These vibrations are ultimately caused by the wind. For any given wire stretched in a permanent location, there will undoubtedly be a certain direction and character of wind that will call forth its loudest tones. Our correspondent's wire may be specially influenced by the south-

erly winds that precede storms. Sometimes rapid alternations of sunshine and shade, by heating and cooling the wire, cause it to elongate and contract rapidly, and maintain an additional series of musical notes. Sometimes the length and tension of a wire stretched between two telephone supports is such that it can harmonically respond to several classes of waves transmitted from distant parts of the line. We thus obtain the very rich effects of the aeolian harp, which, as is well known, has often been said to ring out the finest notes before a storm, and whose action was also attributed to magnetism and other occult causes, until Chladni gave the correct explanation. — Ed.]

An attempt to photograph the solar corona.

Mr. W. H. Pickering having called my attention to his letter entitled 'An attempt to photograph the solar corona,' printed in *Science* for April 3, may I ask you to insert the following lines in the next number of your journal.

The false coronal effects which Mr. Pickering describes are precisely those which might have been expected to result from his optical and instrumental methods. I have in my papers called special attention to the two principal sources of false effects which are present in the form of apparatus employed by Mr. Pickering; namely, the use of a lens, and the position of the drop-shutter which is said to have been 'attached to the lens.'

In some early attempts which I made with lenses, any true coronal effect which may possibly have been upon the plates was completely masked by very strong false coronal appearances and rays, similar to those obtained by Mr. Pickering. These were due, probably, in part to outstanding chromatic aberrations of the lenses, though corrected for photographic work, in part to reflections from the surfaces of the lenses, and in part to a diffraction annulus about the sun's image. It was on account of these, and some other probable sources of error when a lens is used, that I had recourse to reflection from a finely polished mirror of speculum metal. When the mirror was used, all these false effects disappeared.

It is scarcely necessary to remind your scientific readers that the only position in which the drop-shutter can be placed, when an object so bright as the sun is photographed, without introducing strong false coronal effects about the sun's image from diffraction, is in, or very near, the focal plane. 'Attached to the lens,' whether behind or in front of it, a strong diffraction effect is produced upon the plate at the beginning, and again towards the end, of the exposure. If Mr. Pickering will direct his apparatus to the sun, and observe the sun's image on the ground glass of the camera during the time that the drop-shutter is moved very slowly past the lens, he will be the spectator of a succession of fine diffraction effects, which in the aggregate, as far as they were bright enough, must have recorded themselves on his plates. In this way, with care and skill, the sources of other instrumental effects could, no doubt, be tracked out.

In one of my papers my words are, "The moving shutter, being placed very near the sensitive surface, and practically in the focal plane, could not give rise to effects of diffraction upon the plate." I may now add, that, even with the shutter near the plate, care has to be taken that no light is reflected from the edge of the moving plate of the shutter.

I state that with my apparatus, when the sky is free from clouds, but whitish from a strong scattering of the sun's light, "the sun is well defined upon a sensibly uniform surrounding of air-glare, but without any indication of the corona. It is only when the sky becomes clear and blue in color that coronal appearances present themselves with more or less distinctness." Any apparatus intended for photographing the corona must fulfil perfectly these conditions before any serious attempts are made to obtain the corona.

I stated, in a paper presented to the British association for the advancement of science in the summer of 1883, that I had discarded the use of colored glass (or cells of colored solutions) because of the danger of false appearances from imperfections in the surfaces or in the substance of the glass.

Mr. Pickering does not state that his sensitive plates were 'backed' with a solution of asphaltum, or other black medium, in optical contact with the glass, — an essential condition.

No tube, with suitable diaphragms inside, appears to have been used in front of the lens to prevent light falling upon the inside of the telescope tube or camera, and being thence reflected possibly upon the plate. The desirable precaution of using a metal disk, with a suitable surface, a little larger than the sun's image, and placed close in front of the sensitive plate, does not seem to have been taken.

Mr. Pickering says of the violet glass, "By its use, a negative image of the sun's disk was obtained; but without it, the plate gave a reversed image." I found no difficulty in obtaining a negative, or a reversed image, when violet glass was used, by a suitable change of the time of exposure; and therefore Mr. Pickering's time of exposure was in fault, if he wished a different result.

Mr. Pickering says, "Both bromide and chloride plates were provided; but, as with Mr. Huggins, the latter proved to give much the better coronal effects." And again, towards the end of the letter, he says that "chloride plates are more suitable than bromide ones for obtaining an atmospheric corona, just as Mr. Huggins has claimed that they are more suitable for taking a solar one: hence I think one must not rely too much on the ultra-violet sensitiveness of the chloride plate for the separation of the two." Passing by the use of the words 'atmospheric corona' for the false appearances which were due in great part, if not altogether, to diffraction and other instrumental effects, as I have already pointed out, and presuming that Mr. Pickering was not unfamiliar with the greater blackness of chloride plates, especially when developed with ferrous oxalate, he seems to infer some special suitability of the chloride plates to bring out the false effects upon his plates. It may be suggested that Mr. Pickering seems to have used the same length of exposure throughout, "giving an exposure which may be estimated at about a fifth of a second." Now, it is scarcely probable that the bromide and chloride plates possessed the same sensitiveness; and it may have been that the (probably) more sensitive bromide plates were thin from excessive exposure. It may even have occurred that his lens, if corrected for bromide plates, gave an outstanding aberration about H, or a little beyond. Anyway, until these and some other similar points are cleared, it does not seem to me that Mr. Pickering is justified in making the insinuation which seems to lie in the words which I have quoted.

In conclusion, I cannot refrain from expressing great surprise that Mr. Pickering should have mentioned my name in connection with experiments carried out in complete disregard of the conditions to which I had called attention, as essential in a matter

of such extreme delicacy as photographing the corona, and in which no little skill and special experience are necessary on the part of the *photographer* as well as on the part of the physicist.

Mr. Pickering has no doubt received authority from Dr. O. Lohse to say that "he (Dr. Lohse) considers that the halo on his plate is wholly atmospheric, and not coronal;" but Dr. Lohse's published statement reads differently. Dr. O. Lohse's words are, "Es gelang aber dieselben (die schwierigkeiten) zu überwinden und resultate zu erhalten welche zu einer fortsetzung der — hier freilich selten möglichen und mit grösserem vortheil in möglicht hoher lage anzustellenden — experimenten ermuthigen." — *Vierteljahrsschrift der Astronomischen gesellschaft,* xv. 134.

I have not seen Dr. Lohse's plates, and can therefore express no opinion as to the nature of the appearances upon them. WILLIAM HUGGINS.

THE PRESERVATION OF NIAGARA.

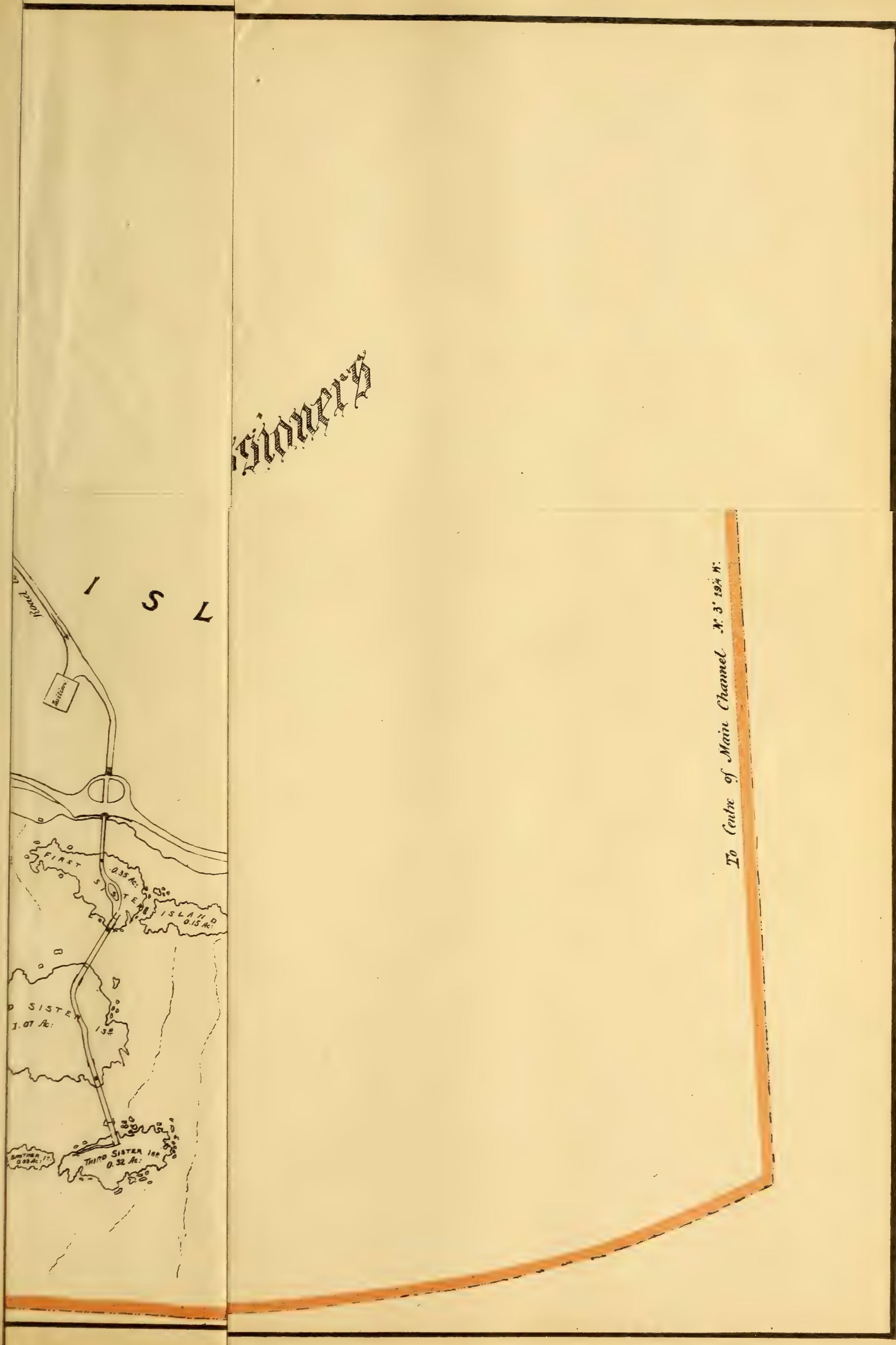
NEARLY seven years ago Lord Dufferin, then governor-general of Canada, suggested to Gov. Robinson of New York that the governments of the province of Ontario and the state of New York should purchase such lands about Niagara Falls as would be required to give free access to the principal points of view, and serve to restore and preserve the natural scenery of the great cataract, beside securing to visitors freedom from those vexatious annoyances which now abound. Subsequently the governor-general called the attention of the government of Ontario to the matter, and recommended co-operation with the state of New York in accomplishing this purpose.

Later, in January, 1879, Gov. Robinson, in his annual message to the legislature of New York, presented this matter, and recommended the appointment of a commission to investigate the question, to confer with the Canadian authorities, to consider what measures were necessary, and to report the results to a succeeding legislature.

By resolution the commissioners of the state survey were charged with the investigation. This commission included some of the most distinguished men of the state, — Ex-Gov. Horatio Seymour, Vice-President of the United States W. A. Wheeler, Lieut.-Gov. Dorsheimer, President Barnard of Columbia college, and others.

With breadth of view worthy of such men, they state in their report, that, "under this resolution, it became the duty of the commissioners to ascertain how far the private holding of land about Niagara Falls has worked to public disadvantage through defacements of the scenery; to estimate the tendency to greater injury; and, lastly, to consider whether the proposed action by the state is necessary to arrest the process of destruction, and restore to the scenery its natural character." In pursuance of these objects, the commissioners instructed Mr. James T. Gardiner, director of the state survey, to make an examination of the premises, and prepare for their consideration a project. He was assisted in this work by Mr. Frederick Law Olmsted, the distinguished landscape-architect.

The examination showed that the destruction of the natural scenery which forms the framework of the falls was rapidly progressing: unsightly structures and mills were taking the place of the beautiful woods that once overhung the rapids; the fine piece of primeval forest remaining on Goat Island was in jeopardy from projects looking to making a show-ground of the island; and every point from which the falls could be seen on the American side was fenced in, and a fee charged for admission. It was found, that, owing to the topography of the main shore, it was practicable to restore its natural aspect by clearing away the buildings from a narrow strip of land 100 to 800 feet broad and a mile long, and planting it with trees which would screen out from view the buildings of the village. When these trees should be grown, and the mills removed from Bath Island, and trees planted there, the falls and rapids would be again seen in the setting of natural foliage which formed so important an element in their original beauty. Every point from which the falls could be seen would also become free of access by the plan proposed. A map was made showing just what lands should be taken to carry out these purposes. The commissioners adopted the plan of Mr. Gardiner and Mr. Olmsted, and recommended to the legislature of 1880 the passage of an act to provide for acquiring title to the necessary lands by the exercise of the right of eminent domain, leaving it to a future legislature to consummate the purchase by appropriating the amount for the payment of the awards, if the sum should seem a reasonable price for the property. Such an act passed the assembly, but was defeated in the senate, although the movement was supported by petitions signed by the most distinguished men of this and other countries. The report of the state survey, with its complete descriptions, illustrations, and maps, then became the basis of a systematic effort on the part of a few determined friends of the falls to educate and arouse public opinion to save the scenery of Niagara. Early in 1883 this


sioners
I S L
FIRST
0.35 Ac.
ISLAND
0.15 Ac.
1.07 Ac.
THIRD SISTER ISL
0.32 Ac.
To Centre of Main Channel

MAP OF
land proposed to be taken by The Commissioners
OF THE
STATE RESERVATION AT NIAGARA
FOR
PRESERVING THE SCENERY OF THE FALLS OF NIAGARA.
SURVEY MADE BY THOMAS EVERSHED, DIV. ENG:
Under the direction of
SILAS SEYMOUR, STATE ENGR & SURR
August ~ Septr 1883.
W. N. Radenhurst C.E. Del:
PHOTO-LITH. BY WEED, PARSONS & CO., ALBANY, N.Y.
Scale.
Four Chains to the Inch.
Table
Of Land proposed to be taken under the Act.
Location. | Acreage.
Land located on Main Shore. 25.530
Made land " " 0.520
Islands 80.006
Made ground on Bath Island. 0.860
Total. — 106.916
The Undersigned Commissioners of the "State Reservation at Niagara" appointed under, and by virtue of Act. Chapter 336 of the Laws of the State of New York of the year 1883: do hereby Certify, that this is the Map of land which they have determined to take for the purposes of said Act; and which they have caused to be made by the State Engineer and Surveyor; to be filed in the Office of the Secretary of State, and in the Office of the Clerk of the County of Niagara.
We also do hereby Certify, that the boundary of the Lands, selected and located by Us, and which we have determined to take for the purpose of preserving the Scenery of the Falls of Niagara, and restoring the said Scenery to its natural condition, is on this Map indicated by the outer margin of the broad pink line, which said outer margin is shown also by a black line forming the same.
Dated New York Decr 8th 1883
William Dorsheimer
M. B. Anderson
J. Hampden Robb
Andw H. Green
Commissioners of the State Reservation at Niagara
Magnetic Variation is 3° 38' 25" West
Note: The Courses shown on this Map are according to the true Meridian.
True Meridian
Magnetic Meridian
Note: Canadian Shore line was not surveyed, but is delineated from Maps of U.S. Lake Survey of 1875.
DOMINION OF CANADA.
NIAGARA RIVER
VILLAGE OF NIAGARA FALLS.
NIAGARA RIVER.
GOAT ISLAND.
COUNTY OF NIAGARA
Suspension Bridge
PROSPECT PARK
AMERICAN FALLS
BIRD ISLAND
NIAGARA ST.
FALLS STREET.
RAPIDS ST.
WATER STREET
CANAL
MAIN STREET
BUFFALO STREET
MILL ST.
FOURTH STREET
RIVER STREET
HYDRAULIC CANAL
International Hotel
To Bath Island Bridge
Road to Bath Island Bridge
Road to Sister Islands
Names of Owners of Goat Island; North half of Bath Island and all the other Islands; and their relative proportion.
Subject to Life interest: Peter A. Porter 6/16ths; George M. Porter 5/16ths
Subject to dower interest: Frederica P. Burrall 2/16ths; Jane A. Porter 2/16ths
Frederica P. Burrall 1/16th
Flat land 62.46 Ac:
Sloping 11.44 "
Total — 73.90 "
Stream divides
HORSE SHOE FALLS
Boundary line between the United States of America and the Dominion of Canada.
To Centre of Main Channel

movement ripened into the organization of an association to promote legislation for preserving the scenery of the Falls of Niagara, Mr. Howard Potter of New York being president, and Hon. J. Hampden Robb, chairman of the executive committee.

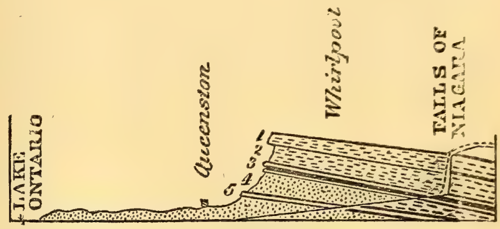
Through the efforts of this Niagara-Falls association, an act was passed, in 1883, providing for a commission entitled 'The commissioners of the state reservation at Niagara,' and giving them power to proceed through the courts to condemn the lands needed. Ex-Lieut.-Gov. William Dorsheimer is the president of this board; and the other members are President Anderson of Rochester university, Hon. J. Hampden Robb, Hon. Sherman S. Rogers, and Andrew H. Green. With some modifications made necessary by changed conditions, they adopted the plan proposed by the state survey. The lands selected were then surveyed, and their value appraised by a commission of very high character, appointed by the court, the total valuation of the lands being $1,433,429.50. The report of the commissioners of the reservation was made to the present legislature, and a bill to appropriate this sum was introduced. The Niagara-Falls association worked in every part of the state to arouse public opinion to the importance of making this appropriation, and the commissioners labored most earnestly among the legislators and the people. The battle was a hard one against ignorance and narrow-minded selfishness; but the victory is complete. The legislature, by more than a two-thirds majority, has appropriated the $1,433,429.50, and the governor has approved the act.

After six years of almost continuous effort on the part of the active friends of this enlightened project, it is secured by a law which declares that the lands are purchased by the state in order that they may be 'restored to, and preserved in, a *state of nature*,' and that every part of them shall be forever free of access to all mankind.

THE NIAGARA GORGE AS A CHRONOMETER.

THE recession of the falls of Niagara will be understood by reference to the accompanying figure.

The strata, as will be seen, dip gently (twenty-five feet to the mile) toward the south. The upper stratum (No. 1) consists of compact Niagara limestone about eighty feet in thickness. Underneath it (No. 2) is the comparatively soft Niagara shale of about the same thickness. Nos. 3 and 5 are also strata of hard rock, with a softer rock intervening. The river formerly plunged over the escarpment at Queenston, about seven miles below the present cataract, and where the perpen-



SECTION OF THE STRATA ALONG THE NIAGARA RIVER, FROM LAKE ONTARIO TO THE FALLS.

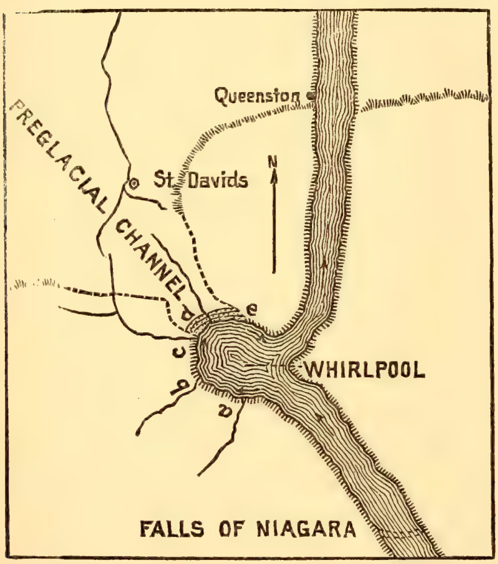
dicular fall must have been upwards of three hundred feet. From that point to the present cataract, the river now occupies a narrow gorge from five hundred to twelve hundred feet in width, and from two hundred and fifty to three hundred and fifty feet in depth. The manner of the recession is easily understood from a glance at the diagram. The softer rocks (Nos. 2 and 4) rapidly wear away, thus undermining the harder rocks above, and leaving them to project over, and finally to break off in huge fragments, and fall to the bottom, where they would lie to obstruct the channel, were it not for the great momentum of water constantly pouring upon them, and causing them to grind together until they are pulverized and carried away piecemeal. The continuity of the underlying soft strata insures the continuance of a projecting stratum at the top, and a perpendicular plunge of the water when passing over it.

Double interest attaches itself to the Niagara gorge, when we consider the evidence of its post-glacial origin, and thus are permitted to regard it as a chronometer of the glacial age.

That the Niagara River can have occupied its present channel only since the glacial period, was shown by Professor Newberry when he proved that the Cuyahoga River, emptying into Lake Erie at Cleveland, occupied in preglacial times a channel about two hundred feet below its present bed, borings in the bed of the Cuyahoga extending that distance in glacial clays before reaching the rock. To receive a tributary at that depth, the level of Lake Erie must, of course, have been correspondingly depressed; and, as the lake is nowhere much more than two hundred feet in depth, we may confidently say, that, before the glacial period, such a body as Lake Erie did not exist, but

instead a wide valley through which a great stream, corresponding to the present Niagara, found its way to the head of Lake Ontario, through a deep and continuous gorge. Professor Spencer, indeed, thinks he can trace the course of this preglacial gorge from near the mouth of Grand River in Canada, northward to Lake Ontario.[1]

We might also infer the relatively late origin of the present channel of the Niagara from the small amount of work which the river has done in its present channel. The Allegheny and Ohio rivers, which lie outside the limit of glaciation, illustrate in a striking degree the extent of *preglacial* erosion. For a distance of more than a thousand miles, these streams occupy a continuous eroded trough, averaging about a mile in width and from three hundred to five hundred feet in depth; whereas the gorge in the Niagara River below the falls is only about seven miles in length.



That the Niagara gorge is post-glacial, was also shown as early as 1841, by Professor James Hall of the New-York survey, who pointed out to Sir Charles Lyell[2] the probable course of a preglacial channel, now filled with glacial *débris* extending from the whirlpool to St. David's, where the level of Lake Ontario is reached. A glance at the accompanying cut will explain the situation. From the falls to Queenston, the perpendicular bank of the gorge, from two hundred and fifty to three hundred feet in height, is continuous upon the east side; but upon the west side, about halfway down, occurs a remarkable indentation known as the 'whirlpool.' Following this bank around, the small streams *a*, *b*, and *c* expose the rock before descending to the whirlpool, and the rocky bank re-appears at *e*. But between *c* and *e* no rock appears, although the stream *d* has worn a channel from fifty to a hundred feet deep. The sides and the bed of *d* consist of the familiar glacial deposit called 'till,' or 'bowlder clay.' The distance from *c* to *e* is about five hundred feet. Following up the channel of *d*, one comes, at the distance of a half-mile, to the general level of the banks of the river above the cataract, and of the escarpment of Niagara limestone, from which the river emerges at Queenston. The opening of the supposed pre-glacial channel to the north-west is, as is shown in the plate, much wider than its entrance at the whirlpool, and the descent of three hundred feet to St. David's is rapid. The broad opening toward St. David's is also filled with gravel rather than with till; and this gravel extends southward over the higher level towards the falls, somewhat like the familiar 'lake-ridges' of Ohio.

It will be seen that the existence of a preglacial channel from the whirlpool to St. David's — a distance of about three miles — is somewhat hypothetical, since for a space of two miles the original features of the country are wholly disguised by the glacial deposit, and no wells have been sunk to a sufficient depth to test the question properly. The well to which Sir Charles Lyell referred was probably about the head of the stream *c*, which is really in the gravel outside the escarpment. Still there is little doubt that before the glacial period there was a narrow gorge, about two hundred and fifty feet deep, extending from the whirlpool, and perhaps a little above it, to the Ontario level at St. David's. But it is equally clear that the river which wore this gorge was not the Niagara, since a stream of that size must, during the long preglacial period (measured by the eroded channel of the Ohio and Allegheny), have worn a gorge far longer than that between the whirlpool and the present falls. The preglacial channel from the whirlpool to St. David's was probably, therefore, as Dr. Pohlman suggests, the work of a comparatively small stream, with a drainage basin occupying not more than two or three counties in western New York.

Considering, now, the gorge from Queenston to the falls of Niagara as the work done by the stream since the close of the glacial period, and

[1] See Second geological report of Pennsylvania, Q^4, pp. 359 sq.
[2] Lyell's Travels in America (first series), vol. i. p. 27.

taking that as the dividend, if we can determine the annual rate at which the falls recede, and take that for the divisor, our quotient will represent the time that has elapsed since the glacial period. The accompanying map gives a more definite idea of that divisor than we have ever before had. The lower dotted line represents the margin of the horse-shoe fall as mapped by the New-York geological survey in 1841, under the direction of Professor James Hall. The upper line is that made in 1875 for the U.S. geodetic survey. By comparing the two, a pretty correct calculation may be made as to the amount of recession of the horseshoe fall in the interval of thirty-four years. This cannot vary much from a hundred feet upon the whole line, being, as the commissioners calculate, two hundred and seventy feet at certain points.

Until this last survey, the attempts to estimate the time required for the cataract to recede from Queenston to its present position have been based upon very insufficient data. Mr. Bakewell, an eminent English geologist, gave personal attention to the problem as early as 1830, and, from every thing he could learn at that time, estimated that the falls had receded about a hundred and twenty feet in the forty years preceding. He recurred to the problem again in 1846, 1851, 1856 (*American journal of science*, January, 1857, pp. 87, 93), and was each time confirmed in the belief that the apex of the horseshoe fall was receding, on an average, three feet a year. On the other hand, Sir Charles Lyell, upon his first visit, in 1841, 'conceived' (upon what basis he does not tell us), that, at the utmost, the rate could not be more than one foot a year, which would give us thirty-five thousand years as the minimum time. But, as it appears, the result of the recent survey is to confirm the estimate of Mr. Bakewell, thus bringing the period down to about seven thousand years.

Two elements of uncertainty, however, tending to lengthen the estimate, should be noticed. In the first place, the recession may have been somewhat slower while the hard stratum, No. 3, was exposed. In the second place, the deposits of gravel running southward from St. David's, and corresponding to the lake-ridges, indicate that subsequent to the glacial period this whole region was slightly submerged beneath a shallow body of water; in which case, the recession of the gorge would have begun only upon the emergence of the land. And we have no means of telling how long an interval may have elapsed between the withdrawal of the ice and the withdrawal of the water.

On the other hand, it is probable that the channel of the preglacial stream extended somewhat above the whirlpool, thus reducing amount of work done since glacial time.

The above estimates are confirmed, also, by the small amount of change that has taken place in the species of animals during that period. The mollusks found in the river above the falls at the present time, are identical species with the shells found in the deserted river-channel at the top of the escarpment opposite the whirlpool, while nearer the falls the bones of the mastodon have been found in the same deposits; all which corresponds with a vast amount of other evidence, going to show that the present species are, in the main, identical with those existing at the close of the glacial period. The theory of evolution is relieved from a heavy burden by supposing a recent date for the close of the glacial epoch; for the changes since that epoch have been so slight, that the time allowed by the physicists is insufficient for the whole development of organic forms, unless the rate of change is more rapid than must be the case if the glacial period is thrown very far back.

G. Frederick Wright.

NIAGARA FALLS CONSIDERED AS A SOURCE OF ELECTRICAL ENERGY.

The first suggestion of the possible employment of Niagara Falls as a source of electrical energy, and the distribution of this energy in the shape of light and power, is due to C. W. Siemens. It was a large suggestion; and it took root speedily in what may be termed 'cosmical minds.' The way, however, to its fulfilment, has not been made plain to business enterprise. The most noteworthy remarks upon the subject were made by Sir William Thomson in 1881, at the York meeting of the British association. His remarks and calculations were in substance as follows: With the idea of bringing the energy of Niagara Falls to Montreal, Boston, New York, and Philadelphia, a total electromotive force produced by the dynamo-machines at the falls was taken at 80,000 volts. This was between a good earth connection at the falls, and one end of a solid copper wire of half an inch in diameter, and three hundred statute miles in length. The resistance of the circuit was so arranged that there should be an electromotive force of 64,000 volts at the remote end, between the wire and the earth connection. The calculations showed that a current of 240 webers

would be produced in the wire, which would take energy from the Niagara end at the rate of 26,250-horse power, and only 5,250-horse power would be lost by the generation and dissipation of heat through the conductors; and thus 21,000-horse power would be available at the cities above mentioned. According to Sir William Thomson's calculation, it will be seen that eighty per cent of the energy would be thus transmitted. He also supposed that the solid copper wire was supported, like the ordinary telegraph-wire, upon poles, and found that an electric spark would not be produced between wires electrified to the difference of potential of 80,000 volts, unless they were within three-quarters of an inch apart: there could not be, therefore, great difficulty in the insulation. The cost of the copper conductor was reckoned at $185,000; and the interest upon this at five per cent is $9,500 a year.

At the time these remarks were made, great hopes had been excited by the invention of the Faure storage-battery; and Sir William Thomson closed his address by a glowing picture of the possibility of keeping a Faure battery of 40,000 cells constantly charged, we will say in New York, and applying a methodical system of removing sets of 50, and placing them upon local supply-circuits, while sets of 50 are replaced upon the main conductor.

The electromotive force of a Faure cell is in the neighborhood of 2 volts; and 50 cells would give 100 volts, which would be sufficient to supply several arc-lights. Thus the great electromotive force of 80,000 volts could be subdivided. Unfortunately, however, it has been found that the Faure battery is not permanent, or even fairly so. It can be said, without exaggeration, that its working-life is less than a year, and during the time of its best estate it cannot be depended upon. Many attempts have been made to perfect the Faure cell, and other forms of electrical accumulators; but no form of storage-battery is a commercial success at this present writing. It is not, however, beyond the power of invention to devise a system of what are called step-down dynamo-machines, by means of which the great difference of potential of 80,000 volts can be subdivided and utilized on different circuits. A number of small dynamo-machines could be connected with the great copper conductor leading to Niagara Falls in such a manner that the energy transmitted by this conductor could be distributed over a large extent of territory, either in the shape of light or power.

The distribution of light from a great central station has already been accomplished. The system of village-lighting devised by Edison can now be studied by those who are interested in the employment of the energy of Niagara Falls for a similar purpose. The limitations of distance apply to the present central electric-lighting stations; and those who are sceptical in regard to the great plan of utilizing Niagara Falls as a source of energy make a strong point when they ask why the system of great central stations has not been rapidly increased. It is true that abundance of water-power takes the place of coal; but the cost of the long conductors, the maintenance of the insulation, and the interest on the cost of any method of subdivision, must also be considered, and may be found to offset the cheapness of the source of the energy. We imagine, moreover, that few towns or cities would be willing to depend for their light on a seat of energy so remote as even fifty miles, to say nothing of three hundred. An accident to the copper conductor, due to the falling of a tree, or to some mischievous action, could plunge a city into darkness. If the conductor were placed underground, defective insulation would enter, and produce the same result. Even if the system of utilizing Niagara Falls as a source of electrical energy should be adopted, a supplementary system of lighting would have to be maintained in every city.

It is not safe to assume, that, if this large scheme of utilizing Niagara Falls could be made successful, business enterprise would already have moved in this direction; for capital, it is well known, is extremely conservative. The true reason that large sources of water-power have not been utilized for electric lighting on a large scale, is due to the fact that the small details, and what are called the small items, assume great proportions, and bid fair to consume all profits which come from a saving of coal. Thus the city of Buffalo could have been lighted by the utilization of the water-power along Niagara River; and we cannot believe that the failure to do so has been due either to the opposition of the gas companies, or to the lack of imagination of capitalists. In short, the facility with which energy in the shape of coal can be transported from place to place counterbalances at present the cheapness of a very remote source of energy in the shape of a waterfall.

The reasons for and against the utilization of the energy of Niagara Falls as a source of light apply also to the question of the electrical transmission of power, with this exception, that the electrical transmission of power has

not reached even the perfection which systems of electrical lighting have attained.

John Trowbridge.

DR. GOULD'S WORK AT THE CORDOBA OBSERVATORY.

[The Boston papers of last week Thursday gave a full account of the complimentary dinner given to Dr. Benjamin A. Gould on his return to this country, after the completion of his long series of observations in the Argentine Republic. We place before our readers that portion of the address made by Dr. Gould after the dinner, which narrates the history of his undertaking, on which he has expended nearly fifteen years. Want of space prevents our giving the introductory remarks in response to the warm welcome which he received from his hosts, or the many other excellent addresses upon the occasion.]

The undertaking began, as you know, with the project of a private astronomical expedition, for which my friends in Boston and vicinity had promised the pecuniary means. The selection of Cordoba as an especially desirable place was chiefly due to our lamented countryman, Gilliss, whose astronomical mission to Santiago de Chile had resulted in extensive and valuable observations of southern stars, and in the establishment of a national observatory, while it had enabled him to form a sound judgment as to the relative advantages of different points in South America for astronomical purposes, notwithstanding the total want of trustworthy meteorological data. This choice of place was confirmed by the counsel of the Argentine minister to this country. That minister was Sarmiento, a man who needs no encomium here; for during his brief residence in the United States he gained an exceptional number of friends and admirers. He transmitted to his government, then under the presidency of Gen. Mitre, my application for certain privileges and assurances, all of which were at once cordially conceded; but his interest in the plan became furthermore so great, that when, soon afterwards, he was himself elected president, he obtained the assent of the Argentine congress to the establishment of a national observatory, and wrote asking me to change my plans accordingly. The official invitation was sent in due time by the minister of public instruction, Dr. Avellaneda. The government assumed the expense of the instruments and equipments already bespoken, and authorized the engagement of the requisite assistants.

In 1874 Dr. Avellaneda succeeded Sarmiento in the presidency, and in 1880 he was himself succeeded by Gen. Roca. Thus four successive administrations have encouraged and sustained the undertaking; and notwithstanding the high political excitement which often prevails, and might easily have disinclined the members of any one party to give cordial aid to institutions established or fostered by their opponents, there has never been wanting a spirit of decided friendliness to the observatory, and to the scientific interests which have been developed under its auspices. No president of the nation, and no minister of the department under which the observatory is placed, has failed to give strong practical evidence of his good will. There has been none of them to whom I do not owe a debt of gratitude. I have never made an official request which has not been granted, and in such a way as to enhance the favor. And just as the official founders of the observatory met us with a cordial welcome on our arrival, so the government of to-day has overwhelmed me with kindness, and tokens of regard, on my departure. On the very last evening before embarking, when it was my privilege to receive the farewells of a crowded assemblage in the halls of the Argentine geographical institute, and to hear words of sympathy and commendation from the lips of Gen. Sarmiento, my earliest Argentine friend, speaking in behalf of that society, I replied in the few words which alone were possible at the time, but with all sincerity and truthfulness, as follows: —

"It was you, sir, who provided the opportunity for which I was yearning: it was the Argentine Republic which made it easy for me to avail myself of it. It has been the national government which, in its various phases, and under so many different administrations, always provided all needful means and resources: it is the Argentine people which has accompanied me in my tasks, giving support by their sympathy, and incentive by their kindness."

The original purpose of the expedition was to make a thorough survey of the southern heavens by observations made in zones between the parallel of 30° and the polar circle; but the plan grew, under the influence of circumstances, until the scrutiny comprised the whole region from the tropic to within ten degrees of the pole, — somewhat more than fifty-seven degrees in width, instead of thirty-seven degrees. And although it was no part of the original design to perform all the numerical computations, and still less to bring the results into the form of a finished catalogue, it has been my exceptional privilege, unique in astronomical history so far as I am aware, to enjoy the means and opportunity for personally supervising all that vast labor, and to see the results published in their definite, permanent form. Of course this has required time. The three years which I had purposed devoting to the less complete work have been drawn out to nearly fifteen; and you will comprehend what that implies for one who loves the friends of his youth, his kindred, and his country. Yet even here there has been consolation. For, while the work has demanded all that period, it did not absorb the whole time, and opportunity was left for other studies. Among the astronomical ones, it has been possible to examine all the stars as bright as the seventh magnitude, up to 10° of north declination, for careful estimates of their respective brilliancy, and to reform the arrangement and boundaries of the southern constellations; also to carry out the observations and computations for another stellar catalogue, more exact than that of the zones, and extending over the whole southern hemisphere. The

total number of different stars in this catalogue is less than in the other; but that of the observations is greater, since each star has been observed many times, as well as with greater precision. This catalogue, too, is at last finished, and in the hands of the printer; and thus it is that I am once more at home with you, my cherished friends.

I am hopeful that the data now collected may throw some additional light upon the great problem of the distribution of the stars in space. Yet, even should these prove insufficient, there is reason to believe that the new labors already begun by my successor, Dr. Thome, who has been connected with the observatory from the very first, will provide whatever additional information may be needful for the purpose. Among the other researches which have gone on while the preparation of the zone catalogue dragged its slow length along, has been a study of the meteorology of the country. The absolute lack of information on the subject had forced itself unpleasantly upon my notice when endeavoring to select the most suitable place for the observatory; and, as it would have been disgraceful for any scientific inquirer to reside in the country without trying to supply the want in some degree, I succeeded in enlisting the aid of various educated men and women in different parts of the country and adjacent ones. The government and congress acceded to my recommendation that a modest sum should be annually appropriated for the purchase of barometers, thermometers, rain-gauges, etc., to be lent to volunteer observers, and for arranging, computing, and publishing the results. In this way was organized, in 1872, the Argentine meteorological office, which has established no less than fifty-two stations, scattered from the Andes to the Atlantic, and from Bolivia to Terra del Fuego. At the end of the year 1884 there were already twenty-three points at which the observations had been continuously made, three times a day, for at least four years, and sixteen others at which they had already been continued for more than two years. These have provided the necessary data for constructing the isothermal lines with tolerable precision for all of South America, from the torrid zone to Cape Horn. Some little has also been accomplished in determining local constants of terrestrial magnetism; and our determinations of geographical position have nearly kept pace with the extension of the telegraph-wires. The beats of the Cordoba clock have been heard, and automatically recorded, amid the plash both of Atlantic and Pacific waves. And the series of longitude determinations made by the U. S. navy expeditions between Buenos Aires and Europe on the one side under Capt. Green, and between the United States and Valparaiso under Capt. Davis on the other, give, when combined with the two South-American measurements, values for the longitude of Cordoba which differ only by one-sixth of a second; this being the total amount of the aggregate errors of the several determinations in a series which, passing through Brazil, the Cape Verde Islands, Madeira, Portugal, England, Ireland, Newfoundland, the United States, Central America, and down the coasts of Ecuador, Peru, and Chile, completes the full circuit at Cordoba again.

But I will not descant upon collateral matters, nor convert this gathering of friends into an astronomical lecture-room. There are but two points more that I wish to mention. One is, that I cherish a hope that our sojourn at Cordoba may hereafter be considered as marking an epoch in a new method of astronomical observation, namely, the photographic. The inception and introduction of this method belongs to our countryman, Mr. Rutherfurd; and it was only through his friendly aid in several ways that I was enabled to give it a larger scope, in spite of many obstacles. Now, I can report that every important cluster of stars in the southern hemisphere has been repeatedly photographed at Cordoba, with a precision of definition in the stellar images which permits accurate microscopic measurement; that these measurements are now actively going on; and that the Argentine government has undertaken to provide the means for their continuance under my supervision. It may be that I over-estimate the importance of this new method; but I confess that my expectations are very high. Another year ought to show us whether they are exaggerated or not.

The other point is, that a very large share of the merit which you so liberally attribute to me belongs to the faithful staff of fellow-workers with whose assistance I have been singularly favored. This unselfish devotion to the great undertakings in which they took part, their loyalty, trustworthiness, and ability, have, in the great majority of cases, been beyond all praise. Happily, their faithful and inestimable services to science are placed on durable record; and yet unborn astronomers will know, at least in part, how great have been their deserts. The senior of them, Dr. John M. Thome, whose services began in 1870, before we started southward, is now director of the observatory, where he has begun a new and important work, which will do honor to him and to the institution. Another, Mr. Walter G. Davis, who has labored most earnestly and efficiently for eight years and a half, is now director of the meteorological office, which is assuming large proportions, and under which he is now organizing a meteorological station of the highest class. One noble young man, Mr. Stevens, was summoned, without an instant's warning, to a higher reward than earth could give, leaving no memories behind him other than of affection, admiration, and respect. It was a sore loss for us, and for the bereaved parents in New Hampshire, to whom he was their only earthly stay and staff. Had he lived, his friends and country would have had abundant cause for pride in him. As it is, the number of those who love and honor his memory may perhaps be smaller, but their pride and admiration are no less than had they seen the full harvest instead of the rich promise only. Mr. Bachmann, a native of Austria, who labored with us for more than ten years, is now at the head of the Argentine naval academy in Buenos Aires, with more than three hundred pupils, and an elegant little observatory, where he finds repose from administrative cares in

astronomical work analogous to that to which he gave his energies at Cordoba. He has already undertaken some longitude determinations, and arranged a time-ball, which is probably already giving daily signals, by which the shipping in the outer roads, twelve miles away, may correct and rate their chronometers.

I have spoken longer than I intended, but will make no apologies, for I know your friendly indulgence. It only remains to say for these Argentine scientific institutions, that I believe their success to be now assured; they will enter upon new and enlarged fields of usefulness, as indeed they ought, for the world moves; and, for myself, that the remembrance of this occasion and of your overwhelming kindness will be a source of pride to me through life, and to my children afterwards.

SEMITIC LANGUAGES AT HARVARD.

IN a programme of the Semitic courses given by Professors Toy and Lyon in Harvard university, we find the following statements interesting to the young student. The Semitic family (one of the two inflecting families of the world, the other being the Indo-European) is divided into two groups, in which the several languages are distributed as follows: —

- North-Semitic.
  - 1. Babylonian-Assyrian.
  - 2. Aramaic.
    - Classical Aramaic (Syriac).
    - Palmyrene.
    - Jewish Aramaic.
    - Samaritan.
    - Various modern dialects.
  - 3. Canaanitic.
    - Phoenician, older and later (Punic).
    - Hebrew, biblical and post-biblical.
    - Moabite, etc.
- South-Semitic.
  - 4. Arabic, classical, and modern dialects of the Bedawin, and of Egypt, Algeria, and Syria.
  - 5. Sabean, embracing several dialects.
  - 6. Ethiopic, and the modern related dialects, Amharic, Tigre, Tigriña.

The two groups differ from each other considerably in grammar and lexicon. A member of either is much nearer to its fellow-members than to any member of the other; thus, Assyrian is more important than Arabic for Hebrew lexicography, and Ethiopic and Arabic are of more value than Hebrew or Aramaic for Sabean. Still, all these languages have much in common with one another, and each throws light on the others.

The choice of a student will depend on his special aim. Aramaic is the simplest Semitic language in forms, is necessary for the study of the Talmud (Gemara), and contains material for biblical textual criticism, and for the ecclesiastical and secular history of the first sixteen or seventeen centuries of our era. Hebrew is indispensable for the critical study of the Old Testament and Talmud (Mishna). Assyrian is grammatically interesting, and valuable for the early history of western Asia, and for North-Semitic civilization in general. Phoenician exists almost wholly in inscriptions, — a few of which are of historical importance (B.C. 500–A.D. 150), — and in Latin transcription in the Poenulus of Plautus. Arabic has most fully preserved the old inflectional forms, is indispensable in the study of general Semitic grammar, and has a large and varied literature, of which the historical part is of great value, and the poetry interesting. Sabean, or Himyaritic, is found only in inscriptions, which have recently revealed the existence of an ancient and remarkable civilization in southern Arabia, and a language presenting noteworthy peculiarities. Ethiopic, nearly related to Sabean, is the language of the Christian period of the Semitic colony in eastern Africa. Its literature consists of a Bible translation, monkish chronicles, and versions of several important apocalyptic books. The grammar is remarkable for the symmetry of the verb. At present it has been replaced by various related dialects, one of which was the language of the late King Theodore of Abessinia.

No genetic relation between the Semitic and Indo-European families has yet been discovered. The lexicon of the one does not help that of the other, and only the most general connection exists between their grammars. It is only a seeming exception to this statement, where one language has borrowed from another, as is the case with the modern Persian and the Hindustani, a large part of whose vocabularies is taken from the Arabic, and the Eranian Huzvaresh, which has taken much from Aramaic. Turkish, a member of still another family, is similarly indebted to Arabic.

THE STONE AGE IN AFRICA.

AT the meeting of the Royal society of northern antiquaries, held April 14, 1885, L. Zinck gave an account of the discoveries hitherto made regarding the stone age of Africa. There was now no doubt that Africa had its stone age, as well as Europe. Both in the old cultivated land of Egypt and the well-known desert of Sahara, the inhabitants in their time had only instruments of stone; but he would speak only about the stone age of South Africa. About twenty years since, was made the first find of stone objects in the region of the Cape of Good Hope. We know now that the natives on the south-west coast of Capeland, even at the end of the sixteenth century, paid extravagant prices for iron, and Magaelhens had before found the natives of Madagascar using weapons of iron. Relics of the stone age are also found among the Bushmen, who were driven back to the Kalabari desert, and whose arrow-heads were of stone. There are found in South Africa, from an ethnological point of view, three peoples, — the Kaffirs, Hottentots, and Bushmen, — who represent three waves of migration. The last are the oldest people of the land, and have in their time extended themselves far to the south, where, in the rocky hollows, they have left monuments of various kinds, executed with much ability. They were acquainted with perspective, and had an appreciation of caricature. The Hottentots later drove them back, but were themselves driven back by the Europeans and the Kaffirs. The last, who came from the north, began to encroach on the Cape territory

at the time of its discovery by Europeans. Although it is only twenty years since they began to make collections of the stone age in South Africa, so many specimens have been found, that an older and a younger stone age may be recognized. As yet have been found no objects of polished stone. For a few years past an English railroad-engineer residing at Natal, who had made many finds, has undertaken to examine all South Africa. From his researches, it appears that there are large quantities of stone implements, both in the sea near the Cape, in the alluvial layers at Natal, and in the mountains. It is impossible to fix the time of these stone objects. Kjökkenmöddings have also been found in many places, near Simonstown and Capetown, and masses where the Hottentots had burned lime from oyster-shells: these do not belong to the present natives, as the Kaffirs never eat shell-fish, and rarely fish. A find has also been made in the caverns, but nothing is known about it yet. In Basuto-land have been found arrowheads of flint. From the older iron age the above-named engineer had found, in the layers of gravel near the rivers, and in large hills covered with forest, and in the diamond diggings at Kimberley, implements and chips at a depth of forty feet, where the diamonds occur. It may be concluded that the stone age dates very far back. This shows that the prehistoric ages are not periods of time, but states of development, — in the case of Africa there was a sudden rise from the stone to the iron age, without any intervening bronze period, — the result, not of development from within, but of commercial intercourse from without.

PARADISE FOUND.

The title of this book will attract attention, and find for it a wide sale. The mode of treatment, and the style too, are such as are most pleasing to the popular mind. The book is very ingenious and learned, but, as it seems to us, conceived and written in the spirit of advocacy rather than in the true scientific spirit. It is true, scientific, as well as every other kind of literature, is laid under contribution; but authorities are used — now a Huxley, and now a Winslow — with little discrimination; and thus conclusions are reached which a cautious science would not accept. Yet we believe the book may be read with profit, even by the scientific anthropologist.

There are few questions connected with man more deeply interesting than the place of his origin; for that he did originate in one place, and not in many places, is now generally admitted. After giving (we think at too great length) the various baseless speculations on this subject, the author states his own thesis; viz., that the cradle of the human race was a north-polar continent, now submerged; the submergence being coincident with what science calls the glacial epoch, and what universal tradition calls the deluge. This view, he contends, consistently explains and reconciles all traditions and all scientific facts.

He proceeds, first, to remove some obvious objections. The climate of polar regions is now unfavorable for human life, as witnesses the melancholy history of polar expeditions; but in miocene times, as shown by its luxuriant forests of temperate and subtropic species, it was wonderfully mild and equable. During this time, too, one or more large bodies of polar land, or perhaps a polar continent, existed where now only the ocean reigns. Good scientific authorities are cited for this belief.

The long polar night may be thought an objection: but he shows that this has been greatly exaggerated; that there is more day and less night at the pole than anywhere else, viz., six months full day, nearly four months twilight, and only two months full night. Add to this the full moon (which would be above the horizon during the polar night) and the auroras, and the polar man would have no reason to complain.

But the most important scientific contribution to his view is the probable polar origin of many existing species. From miocene times until now, there has been apparently a gradual though not uniform refrigeration of climate; and as a consequence a streaming southward, along all longitudes, of species successively originated by change of climate at the pole. This view, first brought forward by Professor Asa Gray, has been most distinctly formulated by Marquis de Saporta. Among the number thus originating and migrating, the author includes man; and he gives much good scientific authority showing that he is not alone in this belief. But the author, we think, overstates the facts. He seems to think all species originated in polar regions; but this is far from true. It is probably true that there has been from miocene times a streaming southward of species originating there, but undoubtedly many species and genera have been formed by modification in the course of migration. It is not impossible that man, too, if derivative in origin, may have been thus formed in the course of migration. This depends much on the time of his southward migration. If, as the author thinks, this took place in the quaternary, then he probably left his home as *man*, and the modifications have since gone only so far as to form races. This point requires more

Paradise found; the cradle of the hnman race at the north pole. By William F. Warren. Boston, *Houghton, Mifflin, & Co.*, 1885. 24+505 p., illustr. 8°.

investigation. If the existence of man in miocene time in France and Portugal be confirmed, then our author is wrong. For ourselves, we do not yet accept the miocene man.

All traditions, too, the author thinks, when rightly interpreted, confirm his conclusion. They all point to a golden age and an original home to the north; they all speak of this home as the centre, — the navel of the earth; they all speak of the revolution of the heavenly bodies about a fixed zenithal pole, the abode of the gods; they all speak of a migration enforced by a deluge. To confirm his interpretation, he quotes from traditions of Chaldeans, Persians, Hindoos, Chinese, Japanese, Egyptians, Greeks, and Scandinavians. Classical scholars will doubtless be interested in his view of Homeric cosmology and geography as represented in his frontispiece. To them we leave the question. The author's view certainly seems plausible.

For the author, then, the place of origin was the north pole; the time of origin, the miocene period. The third question is, What was the character of primeval man? On this question the author takes a somewhat middle ground between extreme opinions. He thinks that primeval man of paradise was wholly destitute of all, even the simplest arts, and therefore, we suppose (although he does not say so explicitly), of language. Nevertheless, he thinks he was endowed with simple, and comparatively noble, religious ideas; and that the revolting bestialities of savage life are the result of retrogression. A cautious science will have little to say on this question; but retrogression is certainly as much a law of evolution as is progression. The author's view is therefore not improbable. Childhood, with its simple faith and reverential love, is certainly a nobler thing than a degraded manhood. For obvious reasons we do not think that traditions of a golden age amount to much as argument.

But when the author sustains the traditional idea of gigantic stature and millennial longevity of primeval man, science will, we think, demur. The popular belief that animals of early times, in comparison with existing species, were gigantic, will hardly bear examination. The true view seems to be this: in the history of the earth, there have been periods peculiarly favorable for the development of different orders and families of animals, during which they increased, culminated, and then declined. The mesozoic was such a period for reptiles, the tertiary for mammals. The time of culmination, however, is never at the beginning, but in the middle or near the end. Is it not possible that the present is such a period for man? All the scientific evidence we have is in favor of increasing rather than decreasing size. Also we would remind the author that the decreasing size of which he speaks was in successive species, and even genera. Will he admit that the Edenic man was a different species, or even genus? He may, indeed, well do so, if he carries man back to the miocene. Again: if he likes analogies of this kind, we would remind him of the very notable increase of brain-size in all families of animals since miocene times. Is he prepared to admit the very small brains of Edenic man?

The millennial longevity we dismiss with the remark that we do not believe it can be sustained on natural grounds.

We are sure the author will thank us for calling his attention to some scientific mistakes. 1. On p. 66, in speaking of polar twilight, he says in substance, that, if twilight continues until the sun is 20° below the horizon, it would make a full polar night of sixty days; but, if until 24° (which he thinks probable), it would make it only fifty days. Now, the inclination of the ecliptic is only 23° 28′: therefore the sun would never get so far below the horizon, and therefore in the case supposed there would be no night at all. 2. On p. 194, speaking of the aspect of the heavens on Pamir plateau, he says that the pole of the heavens is tilted about one-third from its zenithal position towards the horizon. It is nearer two-thirds, for its latitude is about 35°. 3. On p. 412, as an example of degradation instead of progression, the author quotes from *Science* to the effect that the recently discovered Silurian scorpion is a more perfect specimen than any found in later formations; but the writer obviously meant more perfectly preserved specimen, not more perfectly organized animal.

THE LENÂPÉ AND THEIR LEGENDS.

THE *Walam olum* (or 'picture record') of the Delawares has long been known to scholars, though imperfectly, as one of the most remarkable productions of the Indian intellect. It was discovered about the year 1820, somewhere in the west (exactly how or where is uncertain), by that eccentric naturalist and antiquarian, C. S. Rafinesque, who held for some years the very comprehensive professorship of the 'historical and natural sciences' in Tran-

The Lenâpé and their legends; with the complete text and symbols of the Walam olum. By DANIEL G. BRINTON, A.M., M.D. Philadelphia, *Brinton*, 1885. (Brinton's library of aboriginal American literature, No. 5.) 6+262 p., illustr. 8°.

sylvania university, Kentucky. After his death in 1840, the manuscript of the Delaware record came for a time into the hands of the distinguished archeologist, Mr. J. L. Squier, who in 1848 read before the New-York historical society an incomplete summary of its contents, giving only a portion of its Indian text and of the symbols. This was published soon after, in the *American review*, and has been since reprinted in other publications. Thus enough has been known of this singular composition to excite the curiosity of students of Indian archeology, who have long regretted the disappearance and supposed loss of the original manuscript. By persistent inquiry, Dr. Brinton has succeeded in recovering it, and has now published the work in full, with all the mnemonic signs, the Delaware text, a new and exact translation, an ample introduction, and many useful notes.

Rafinesque's peculiarities, and some other circumstances have caused a doubt to be cast on the authenticity of the *Walam olum*. The evidence adduced by Dr. Brinton, however, seems quite sufficient to show that it is a genuine Indian production, though its date and authorship are uncertain. Any one who will compare the symbols, or picture-signs, in this work, with those given by the native historian, Copway, in his 'Traditional history of the Ojibway nation,' will be satisfied that they belong to the same system of notation. In fact, of the fifty symbols depicted in Copway's book, about half appear in the *Walam olum*, either precisely the same, or with just such variations as might be expected in an independent work. These symbols are, in part, rude representations of natural objects, — sun, moon, and stars, man, snake, fish, river, canoe, and the like, — bearing, as might be expected, a certain resemblance to the curt pictorial outlines from which the Chinese characters were developed. Besides these, there are some purely conventional symbols, which are found both in Copway's book and in the present work, and which show that Indian inventiveness had already passed into the higher stage, in which ideas as well as objects are represented. A hollow square or parallelogram signifies 'great.' A circle with a point in the centre is the sign for 'spirit,' and, when made of unusual size, indicates 'the great spirit.' Four angular points jutting from it in opposite directions represent the cardinal points, and convey the meaning of 'the great spirit everywhere.' Thus the Lenâpé and the Ojibways were on the very verge of that Egyptian method of word-pictures which preceded the invention of the alphabet.

Each symbol of the *Walam olum* recalled to the mind of the record-keeper the verse or strophe of a chant. Thus, when he drew forth from his bundle of 'painted sticks' the one on which this symbol of the great spirit was depicted, he recognized it as indicating a well-known verse of five Lenâpé words, which are here given opposite the symbol, and which Dr. Brinton's version renders, "At first, forever, lost in space, everywhere the great Manito was." In about two hundred such strophes, indicated by as many symbols, we have the Lenâpé cosmogony set forth, followed by a history of the early wanderings of their people, and a list of ninety chiefs who successively held the headship of the tribe. Many interesting questions are raised by this history, which Dr. Brinton has not undertaken to answer; but he has supplied abundant materials and aids for students who desire, as doubtless many will, to pursue this attractive investigation.

His introductory chapters furnish a succinct account of the tribes of the Algonkin stock, and of their neighbors the Iroquois, whose history is closely connected with their own. The political constitution of the Lenâpé septs, their mode of life, their religious belief and ceremonies, their moral and mental character, are concisely but clearly delineated. Their language is carefully analyzed; and the existing sources, in print and manuscript, from which a knowledge of it may be obtained, are more fully recorded than has ever before been done. Certain disputed points in the later history of the nation are well discussed, though in some of these the author must expect to encounter opposing views. Throughout this introduction, and indeed in the whole work, the marks of great labor and of conscientious care are apparent. Evidence also is seen of the insight derived from long-continued study of the Indian character, customs, and languages. The volume will not merely be in itself a most valuable acquisition to all students of American archeology, but might well serve as a model for future inquirers who may have occasion to undertake similar researches.

KINGSLEY'S MADAM HOW AND LADY WHY.

We once heard an eminent actor describe Charlotte Cushman as "a magnificent example of a style of acting now happily passed by."

Madam How and Lady Why, or first lessons in earth-lore for children. By Charles Kingsley. New York, *Macmillan & Co.*, 1885. 18°.

Some similar phrase would be the best formula for Charles Kingsley's book, now reprinted as one of Macmillan's 'Globe readings from standard authors.' The style it represents is not, to be sure, the old plain-dealing manner of Mrs. Marcet and her 'Conversations about common things,' where John and William demurely put hard questions, and Mr. A. or Mr. B. sedately answers; but it is the modern, rollicking, galvanized form of the same thing, where the preceptor calls himself 'Daddy,' where the pupil is addressed as 'My dear child' on almost every page, and 'My pretty boy' occasionally, where the plain facts about rocks or fishes must be garnished with all manner of metaphor and rhetoric, and where every chapter must wind up with a high-flown rhythmical passage composed of Ruskin-made-easy. To those who like that sort of book, it may be said, borrowing the words of President Lincoln, that 'this is just the sort of book they will like.' But we confess ourselves not to be of that opinion.

Unless we greatly mistake, the taste, even of children, has now changed for the better. It is not now thought necessary to write down to them; to pet them, so to speak, in printer's ink; to remind them in every other sentence of the fact they know best, namely, that they are not grown up. It has been discovered that what they need is merely the straightforward simplicity of language which even grown people like best. It is not necessary to take every common fact and turn it vivaciously into a metaphor; to personify two new intermediate agencies in the universe under the names of 'Madam How' and 'Lady Why,' and then to provide them with two grandsons, 'Analysis' and 'Synthesis' (p. 158); all these personifications being, after all, so ineffectual that the author has to bring in at last a higher creative power (p. 10), called the 'Master,' whom they all obey, and the reference to whom makes this labored mythology very superfluous. This is the head and front of our objection to the book, — that it is not truly scientific, because it is not simple. It tends to impair, not to foster, the spontaneous love that children have for the fascinating truths of out-door nature: it is an attempt to make sandwiches with sugar-plums, and to flavor bread and cheese with vanilla.

This fundamental defect pointed out, it must undoubtedly be admitted that this little book contains a great deal of valuable and interesting knowledge conveyed often in an exceedingly graphic way. Even here, however, there are two drawbacks. One lies in the character of Canon Kingsley's mind, which was dashing, impetuous, and always ready for too sweeping conclusions. To say, for instance, almost at the beginning, "I never saw a valley however deep, or a cliff however high, which had not been scooped out by water" (p. 25); and to reiterate again and again that 'water, and nothing else,' has done all these things, without a word of reference to volcanic action, or upheaval, or subsidence, or lateral pressure, — is certainly a very loose and unguarded way of writing. Again: there is the minor objection that the book, being prepared specifically for English children, is very properly full of local references and illustrations that will mislead and perplex young Americans, just as the older men among us used to be perplexed in childhood by trying to identify the birds and plants around us with the very different species described in the English manuals. Many of the author's most important illustrations of the formation of mountains and valleys, for instance, are drawn from the features of those miniature cañons on the English coast — in the Isle of Wight, for instance — known as 'chines' (pp. 18–22). But what American child knows, or how many American teachers, indeed, know, what a 'chine' is? The word does not even appear in Worcester's 'Dictionary,' except as meaning a piece of an animal, or part of a vessel.

A MONOGRAPH OF BRITISH FOSSIL BRACHIOPODA.

WITH the present appendix (vol. v. part iii.) a monumental work has been brought to a close. The labors of Thomas Davidson, F.R.S., need no introduction to paleontologists of any part of the world. The quiet distribution of the concluding fasciculi of the 'British fossil Brachiopoda' should not be allowed to pass without notice.

Thirty years have passed since the publication of the general introduction to the first volume of this monograph. Coincidently with, and largely induced by, its progress, a vast amount of precise knowledge has been acquired and made public, in regard to all that relates to the history and distribution of the brachiopods. Indeed, our knowledge of them, in any sufficient sense, may be almost said to date from about the time when the learned author began his labors; and the earliest known reference to them in any printed work dates only from 1606. The present appendix closes a series of researches, begun just half a century ago,

on the brachiopods of the British islands. During that period, Mr. Davidson has not only prepared the text of his monograph, and numerous collateral and frequently very important papers on the general subject, but has drawn with his own hand more than two thousand admirable and artistic plates by which that text has been illustrated and adorned. Seldom has fortune equipped more completely a student for his life-work than in the present case, when more than ordinary artistic talent, a liberal education, independent means, were joined to unsurpassed devotion in the pursuit of knowledge, and impartiality in the recognition of the labors of others in the same field.

The steady stream of information induced by the publication of successive parts of the monograph has necessitated supplement after supplement. The present and concluding part not only contains such material, but a catalogue of, and index to, the British genera and species, bibliographical and stratigraphical, and, more important than either for the general biologist, a summary of progress in our knowledge of the class up to the present time. This includes notices, under separate heads, of the test, the embryology, the affinities, the adult anatomy, habitat, and ranges in depth, of recent species, characters of the fossil genera, and classification discussed by families. Full space is allotted to the advocates of contending theories: Kovalevski's valuable paper on the embryology is given in full abstract, with excellent figures; various suggested pedigrees are quoted; the brilliant rise, and slow but continuous decadence, of the 'worm theory,' is related, with generous recognition of the sagacity of Morse in the detection of affinities to which the then imperfect knowledge of the molluscan pedigree, and his remarkable researches into the early stages of Terebratulina and Lingula, lent a plausible, but, as it has since proved, a one-sided interpretation. The general conclusion is reached, that, however great the probability of continuous descent, with modification, as an explanation of the various forms of brachiopods now or previously existing, the paleontological record presents many facts inexplicable by, or even opposed to, this theory; while of natural selection there seems to be absolutely no visible trace. The number of British forms which, at the commencement of the work, numbered 13 genera, and 454 partly invalid species, has now expanded to 74 genera, and 976 species and varieties, to which even now accessions continue to be made.

In taking leave of his task, so worthily performed and to be continued by younger hands, the author, in spite of certain infirmities, does not relinquish his studies, but is now engaged on a monograph of the recent species, which it is to be hoped he may be spared to complete to his own satisfaction and the undoubted benefit of science.

W. H. DALL.

NOTES AND NEWS.

— THE prize of 500 francs, founded by Augustin-Pyramus de Candolle, has been awarded to Professor Planchon, professor of botany at Montpellier, for his memoir on the Ampelidees.

— A geographical society has been established at Rio de Janeiro, under the presidency of Viscount de Paranaguá, with Baron Teffé and Señor Henriques, vice-presidents; Carlos Montéro and Pereira Coruja, secretaries.

— According to the *Oesterreichische monatsschrift für den orient*, the preference shown in England and her colonies for Indian teas is causing considerable anxiety among the native and European tea-establishments of China. Calcutta alone sent to England, in the past year, 62,773,187 pounds, against 58,830,478 in 1883, and 51,579,740 in 1882; while the Australian and New Zealand markets received, in 1884, 1,029,-463 pounds, against 696,479 in 1883. To be sure, this figure shows a great falling-off from 1882; yet at present a preference is manifested in Australia for Indian teas, which, like those of Ceylon, whose production probably has a similar future, far surpass in quality the average teas of China. Also the success of Natal, in the production of tea, warrants the assumption that South Africa will soon enter the market. The total export of Foochow, the greatest tea-depot of China, amounted, in the last season, to 77,631,997 pounds, against 81,100,875 for the same time last year. In Hankow, Canton, Shanghai, and Macao the same proportion is seen. The falling-off in the export of all China against the past year amounts to about ten million pounds, and may be ascribed to the reduction in quality of the Chinese teas. How far this decrease may have been due to the French operations cannot be told.

— Another party for the scientific exploration of Greenland is being organized by the authorities at Copenhagen. It will be commanded by the naval lieutenant, J. A. D. Jensen, assisted by Lieut. C. H. Ryden.

— In a recent visit to Russian Lapland, Rabot visited the valleys of Pasvig and Talom and Lake Enara. The entire country is an immense forest, dotted with lakes and pools, and cut by rapid streams. The latter, though very difficult of navigation, form the sole roads of the country. The Pasvig, for instance, in its course, forms more than thirty cascades and rapids. Lake Enara, from which it flows, is an interior sea, dotted with thousands of islets covered with magnificent pines. The climate is very rigorous; the short summer is, however, quite hot, but in August frosts are not unknown. The country around Lake

Enara is level, and forms a depression between the plateau of Finmark and the highlands of Russian Lapland. This, in a political point of view, is important; since it permits of comparatively easy communication between Finland and the coast of the Northern Ocean. There are excellent ports on this shore never obstructed by ice, but hitherto useless for want of communications with the interior. In the near future, the railway, which has already reached Uleaborg, will be completed to the northern coast, and Russia will be able to utilize a part of her possessions, at present little better than a wilderness.

— Van Braam Morris, Dutch resident at Ternate, has recently made some interesting discoveries on the northern coast of New Guinea, which he visited officially for the purpose of familiarizing the natives with the Dutch flag, and arranging a peace between several contending tribes. After determining the longitude of Mapia, it was found that Stephen Island of the charts has no existence. The coast near Walckenaer Bay was visited; and several rivers of considerable size, as well as a large lagoon, were found, which were before unknown. The population, calling themselves Bongos, were numerous and friendly, living in houses built on piles in the water. Cocoanuts were so abundant that two hundred and fifty could be purchased for twelve cents; and large quantities of kopra are made. Subsequently the Amberno River was visited, and ascended sixty miles or more with a depth of six fathoms, with a fathom less in the channel over the bar. In latitude 2° 20′ south, the river emerges from the mountains; and here were shoals beyond which the party did not go. The current was extremely rapid. The male inhabitants of its banks were timid but friendly: the women always took refuge in the forest. They call the stream 'Mamberan' (or great river). It has never been ascended by civilized man; and it is claimed that the results of Van Braam Morris's explorations are more important to geography than any work done in this region during the century, and only second in New Guinea to the work of Albertis.

— Messrs. Charles Scribner's sons published, May 1, the book of Stepniak, the nihilist writer, author of 'Underground Russia,' entitled 'Russia under the tzars.' The timeliness of its publication is a matter of accident, as the author and translator have been for some time superintending its passage through the press in London; but it is particularly welcome at a moment when universal attention is fixed upon its subject.

— Within a week of the publication of Messrs. Scribner's authorized edition of 'The Russians at the gates of Herat,' they were obliged to print nine thousand copies to supply the demand, and another edition of three thousand has just been put on the press.

— Reports from Japan state, says *Nature*, that grave fears were entertained of an outbreak of the long quiescent volcano Fujiyama, and that officials had been sent to investigate the matter. The people living in the neighborhood believed an eruption to be imminent, because, while the snow on the mountain had begun to melt two months before the usual time, all the wells at the fort became dry, and difficulty was experienced in procuring water. The phenomenon is considered the more remarkable from the fact that the winter has been unusually cold, and that the surface of the snow remains hard, the part nearest the ground being the first to give way.

— The council of the New-England meteorological society has deemed it advisable to select a new subject for special study during the summer season of 1885, and has chosen thunder-storms as offering at once the greatest number of features easily observed, and promising in return the most interesting results. The desired observations will be divided into several classes, in order to bring the work within the reach of all who are willing to take a share in it. Observations are to be taken through the summer whenever a thunder-storm can be seen or heard. Besides these, special observations of wind, temperature, etc., are desired on the Saturdays of June (June 6, 13, 20, 27), at intervals from noon to nine o'clock P.M., whether a thunder-storm is in progress or not. Saturdays are chosen with special reference to securing assistance from the scholars in our many schools. Instructions, and blanks for records, will be sent on application to W. M. Davis, Cambridge, Mass.

— Vol. i. of the Transactions of the scientific association of Meriden, Conn., which has just been printed by the association, appears as a tribute to the memory of a deceased member, Miss Emily J. Leonard, whose catalogue of Meriden plants, left incomplete at her death, occupies the principal part of the pamphlet. Although the plant names have in a few cases served as stumbling-blocks in the way of the editors, the list, which includes 749 phenogams and pteridophytes, is very creditably presented.

— *Nature* reports that the National fish-culture association of England has transferred another large consignment of white-fish fry to the lakes in the Isle of Mull in order to further their acclimatization to the waters of this country. Hitherto many experiments have been tried in this direction, but with no success. The American government is rendering valuable assistance in effecting their propagation, and are watching the result of the endeavors now making with keen interest.

— The French government has granted the use of the Palace of Industry, in the Champs Elysées, for the purpose of holding the Great industrial exhibition (*Exposition du travail*), which will remain open from the 23d of July until the 23d of November, 1885.

— The collections and library of the New-Orleans academy of sciences have been removed to rooms furnished by the Tulane university. It is hoped that some additional vigor may be imparted to the academy by the presence of the scientific men visiting the exhibition. E. T. Merrick, ex-chief-justice of Louisiana, is president.

— Systematic observations of auroras have been made at the Engineer station, Willet's Point, N.Y., under the direction of Gen. H. L. Abbot since 1870.

The uniformity and continuity of the system of observations make the results of much interest. Three sentinels are on duty during the night, and each is required to report, when relieved, whether he has seen any auroral light during the night, and, if not, whether the sky has been sufficiently clear to permit any to be visible. At the end of the year the number of auroras, taking the mean result from the three observers, are added, and also the number of nights on which auroras could not have been seen owing to clouds. The probable number for the year is obtained by increasing the observed number in the same ratio as that of the cloudy nights to the clear nights. The results are shown in the following table. The last column of the table gives the average number of sun-spots as observed by Prof. D. P. Todd.

Summary of auroral records for fifteen years.

Year.	Clear sky.		Cloudy sky.		Total for year.	Average no. of sun-spots.
	Nights.	Observed auroras.	Nights.	Probable auroras.		
1870 . .	184	50	150	41	99	–
1871 . .	211	60	154	44	104	–
1872 . .	234	60	132	34	94	–
1873 . .	214	54	151	38	92	–
1874 . .	190	18	175	17	35	–
1875 . .	189	14	176	13	27	–
1876 . .	195	9	171	8	17	–
1877 . .	191	7	174	6	13	2.6
1878 . .	185	2	180	2	4	2.2
1879 . .	204	9	161	7	16	2.0
1880 . .	216	13	150	9	22	14.3
1881 . .	191	23	174	21	44	26.7
1882 . .	201	55	164	44	99	28.3
1883 . .	215	24	150	17	41	27.4
1884 . .	180	12	186	12	24	38.0

— According to the explorer, Col. Prjevalski, Thibet appears to be a paradise for gold-diggers. In the letter in which he describes the discovery of the sources of the Yellow River (the Hoang-ho), he writes: In the neighborhood of the southern slope of the Burchan-Budda, we met with about thirty friendly Tauguts, who were employed in gold-washing. The whole of northern Thibet seems very rich in gold. At the gold-washing place we visited, the Tauguts were digging the gravel containing the gold from a depth of only from about one to two feet; and, though the gold-washing was only done in the most primitive way, the Tauguts showed us whole handfuls of gold in large pieces, of which none were smaller than a pea. Doubtless, careful working of the gold-washing process would yield enormous treasures. It seems to me, too, that the prophecy is not too bold, that Thibet, in time, will prove a second California.

— Dr. Aurel Schulze, the son of a German colonist in Natal, has recently returned from a successful journey into the interior. He advanced up the Kuando, or Chobe, for a considerable distance, and proceeded thence to the Kubango, where his farther progress to the west coast was stopped through the hostile attitude of the natives. He returned to Natal by way of lake Ngami and the Transvaal.

— A. Riche has presented a report to the Council of hygiene of the department of the Seine, in which he states that vaseline should not be used for alimentary purposes, as it is injurious to health. This substance has been recommended for use in pastry, as it is said to show no tendency to become rancid.

— The Académie des sciences offers for this and the three following years a medal of the value of three thousand francs, for some important improvement in the theory of the electric transmission of work. The Bordin prize of three thousand francs is also to be given for the best memoir on the origin of atmospheric electricity, and the causes of the great development of electrical phenomena in storm-clouds; this to be sent in before the 1st of June next, the other before the 1st of June, 1886.

— Tea-cultivation is making some progress in Italy. In the province of Novara a plantation is reported to be doing well; and at the agricultural show at Messina, in 1882, Signor d'Amico exhibited a hundred plants three years old, that had been grown in the province of Messina. The Italian government has sent to Japan for a supply of plants.

— The prize offered by the Société d'encouragement pour l'industrie nationale, of forty pounds, for the discovery of 'a new alloy useful in the arts,' has been awarded to P. Manhès, on account of his discovery of the value of an alloy of copper and manganese for improving the quality of commercial copper. Manhès prepares an alloy of seventy-five per cent copper, and twenty-five per cent manganese, and adds it in small quantities to the molten copper after refining and just before casting, stirring the bath of metal at the same time. The manganese of the alloy is stated to immediately combine with the oxygen of the dissolved cuprous oxide, forming a manganiferous slag which is easily removed. The operation is cheap, and very much improves the quality of the copper so treated. Also several of the principal alloys of copper, bronze, gun-metal, brass, are of superior quality when prepared with copper purified in this manner; and copper so treated is more slowly acted upon by sea-water.

— Obrecht published, in a recent number of the *Comptes rendus*, his result for the solar parallax as derived from measures of the photographs of the transit of Venus of 1874, obtained by the astronomers of the French expeditions. The value found is 8.80″, but it is not final, having still to be corrected for some elements in the calculation whose precise value is as yet unknown. A few years ago, Professor Todd, in a similar way, obtained a preliminary result from the American photographs of the same transit, which was 8.88″ for the solar parallax.

— 'The sun,' by Rev. Thomas W. Webb (New York, *Industrial publication company*, 1885), is 'a familiar description of the sun's phenomena.' It is after the style of the scientific primers, and gives in seventy-seven small pages of coarse type a clear idea of how the distance of the earth from the sun is determined, and of what is going on upon the sun's surface.

SCIENCE.

FRIDAY, MAY 22, 1885.

COMMENT AND CRITICISM.

As we look back at the literature of modern physiology, — a retrospect suggested by the recent appearance of an index to Pflüger's *Archiv für physiologie*, — two facts especially impress us: first, that the bulk of the researches comes from Germany; secondly, that modern experimental science is scarce over forty years old, but has developed in extraordinary crescendo. There is, perhaps, no other science so pre-eminently German, and to which other nations have contributed relatively so little. In Germany the first physiological laboratories were founded, and these have become important 'institutes,' which are the patterns other countries are now slowly imitating. In Germany the science first became strictly experimental, and its modern methods and aims were wrought out. The German universities have been the training-places of the majority of professional physiologists the world over, and these men have been the apostles of German influence.

Our indebtedness to modern physiology can hardly be over-estimated; for its acquisitions represent not only an invaluable intellectual evolution, but also knowledge of immeasurable utility in manifold practical aspects. It has changed medicine from a crude empirical art to an intelligent application of science, and has done more than any other cause to raise the mental status of the medical profession by inculcating the rational foundation of the practice of medicine. The chief initiatory impulse to modern physiology was given by the greatest of German biologists, Johannes Müller, — a man remarkable alike for his own intellectual achievements, and for the stimulus he imparted to others. He was one of the chief founders of the sciences of morphology, physiology, and comparative anatomy. His influence in physiology has been perpetuated by his distinguished pupils, notably the veterans, Ludwig, Helmholz, Brücke, and Du Bois Reymond, who are living to see two generations of followers. Thus the young physiologist of to-day might be called the great-grand-pupil of Johannes Müller.

The literature of physiology has grown with constantly expanding rapidity. At first the memoirs were scattered in numerous scientific and medical publications, but soon two periodicals acquired the lead as media for the announcement of physiological discoveries. Müller's own *Archiv* expressly included physiology in its scope, as did also the *Zeitschrift für rationelle medicin*, a journal of high scientific rank. It was long before there was any periodical exclusively devoted to physiology, Pflüger's *Archiv* not being founded until 1868. At first Pflüger's volumes were annual, but at present he issues nearly three volumes a year. Since then two other first-class physiological journals have been started in Germany. Hoppe-Seyler edits a new and successful *Zeitschrift für physiologische chemie;* and the continuation of Müller's *Archiv* has been divided, the physiological part now forming a separate annual volume. The annual report on the progress of physiology, giving abstracts only, alone makes a bulky volume, which shows, moreover, that nearly all the papers are in German. While the extraordinary development of physiology in Germany has been going on, what have other countries contributed? Very little. There are only two other physiological journals of any note, — one decidedly second-rate, in France; and another the outcome of the combined efforts of England and America, which, though excellent scientifically, is uncertain as to its viability. In short, the

world depends, now as formerly, mainly on Germany for the progress it makes in the knowledge of the functions of life.

"IT IS ONE of the melancholy things connected with publication in government reports," writes one connected with the government, "that your work appears so many years after it has been completed, that the author has in the mean time quite outgrown it, and developed into another stage of opinion and activity." This is not a matter of months only, but of years, and, though not so serious a difficulty as formerly, is still a great drawback to efficient and effective work. The administration of the public printing-office is such that every thing has to give way to congressional documents which are often of the smallest value. Is there no remedy for this uncomfortable state of things?

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Progress of vegetation in the Ohio valley.

THE spring of the present year has been very late in the valley of the Ohio; so late, indeed, that nearly every one has said that it has not been so long coming for many years. A review, under these circumstances, of a record kept of the early-flowering plants for eight years, may be of interest. The first appearance of flowers is a more reliable indication of the state of the weather than the thermometer. Plants indicate the general average of climatic conditions; and the species, appearing in much the same sequence, indicate the progress of spring. In the table of fifteen species here presented, of the first flowers which generally appear, a number of facts are to be noted. It is to be noticed that every alternate year is a cold year, or one, at least, with a late spring. The years 1874, 1876, 1878, and 1884 are early ones, while 1875, 1877, 1883, and 1885 are late.

In 1874 eleven out of the fifteen plants were observed between March 19 and 26, a period of eight days; in 1876 nine out of the fifteen were seen between Feb. 12 and March 14, just a month; in 1878 the eleven of which there is record were found between March 3 and March 18, or sixteen days; while in 1884 the thirteen were recorded between March 16 and 30, or fifteen days. These were the early years. In 1875 fourteen out of the fifteen bloomed between March 30 and April 11, or in thirteen days; in 1877 two were out on March 4, none others until April 1, and between that and the 12th twelve came out; in 1883 two were out on March 4, one on March 13, and ten between April 6 and 12; lastly, in the present year the first flower did not appear until April 1, and thirteen others bloomed up to the 20th.

Account is here taken of only fifteen species. More than this number appeared during the time between the earliest and latest dates; but the ones here considered may be regarded as the *typical* early flowers. They represent eleven different orders.

The earliest year of the eight is 1876. In that year the spring cress (Cardamine rotundifolia) was in bloom Feb. 12, and the dandelion (Taraxacum dens-leonis), generally the earliest composite, on April 7. In 1875 the first flower, red elm (Ulmus fulva), was in bloom March 30, and the dandelion on April 29; while in the present year, in many respects the counterpart of it, the first flower, white maple (Acer dasycarpum), was out April 1, and the dandelion on the 26th. But even 1875, the latest of all, was, on an average, six days in advance of this year. This season is, then, nearly a week later than any in eight recorded years, and is seven weeks and two days behind the earliest year (1876) of the same eight.

In scanning the list, it is further found that three out of these fifteen early flowers are trees; nine of the remainder are provided with bulbs, tubers, or rhizomes, in which nourishment is stored up; one (Anemone acutiloba) has persistent evergreen leaves; and only the remaining two (Capsella and Taraxacum) seem to have no special fund upon which to draw. The importance, then, to herbs, of a store of matter

SPECIES.	1874.	1875.	1876.	1877.	1878.	1883.	1884.	1885.
Acer dasycarpum	–	4–4	2–26	4–1	3–8	3–4	3–23	4–1
Symplocarpus foetidus	4–19*	4–6	2–13	3–4	3–3	3–4	3–18	4–5
Erigenia bulbosa	3–26	4–6	2–13	4–1	3–3	4–8	3–16	4–5
Anemone acutiloba	3–19	4–6	4–2*	4–1	3–8	4–6	3–23	4–12
Sanguinaria Canadensis	3–29	4–8	–	4–1	–	4–12	3–24	4–12
Ulmus Americana	3–22	4–4	2–27	4–1	3–8	4–6	3–16	4–6
Ulmus fulva	3–19	3–30	2–27	4–1	3–10	4–6	3–28	4–10
Cardamine rotundifolia	3–22	4–7	2–12	3–4	3–8	3–13	3–23	4–18
Erythronium albidum	3–26	4–8	3–14	4–12	3–18	4–12	3–23	4–18
Claytonia Virginica	3–22	4–6	2–13	4–1	3–8	4–8	3–24	4–18
Capsella bursa-pastoris	3–22	4–7	4–2*	4–2	3–10	4–13	3–30	4–19
Anemone thalictroides	3–22	4–7	3–12	4–1	3–10	4–6	3-27	4–19
Dentaria laciniata	4–6	4–11	4–2*	4–7	–	4–12	3–30	4–20
Jeffersonia diphylla	4–20	4–11	–	4–8	–	–	–	4–20
Taraxacum dens-leonis	4–19	4–29	4–7	4–15	–	–	–	4–26

* These were probably in bloom at an earlier date than this; but they are so recorded in my note-books, and were seen first on the dates given.

which can be speedily utilized at the first opportunity, is here well shown. JOS. F. JAMES.

Cincinnati, April 28.

Prehistoric fishing.

In Professor Rau's interesting work on prehistoric fishing is a series of Indian bone and horn fish-hooks, ending with a figure that I sent him of one found on an early site on the line of Onondaga county, N.Y. I was especially interested in this object; because it was the first thing found there that seemed to show any knowledge of Europeans, although the site was connected with later sites, near by, by several peculiar relics. The general form of the hook, with its distinct barb, was so like some of the present day, that I naturally thought the Indian maker had at least seen a white man's hook. The series in Professor Rau's work gave rise to doubts, as the main difference in this and others figured was in the barb. I was thus led to see the force of Dr. Rau's remark in his introduction: "I would not venture to say that barbed fish-hooks had been unknown in America in ante-Columbian times; I simply state that none have fallen under my notice."

In looking over some drawings of relics made about three years ago, my attention was arrested by one which I had labelled 'horn perforator.' The more I looked, the more the conviction strengthened that it was the barb of a fish-hook. Borrowing the fragment, I drew it again, after careful examination, and then sent the fragment to Dr. Rau for inspection. He says, "It certainly has the appearance of the barb of a fish-hook." The fragment is one inch and five-sixteenths long by about one-twelfth of an inch thick; from the point to the present end of barb, fifteen-sixteenths of an inch; while the width at the barb is about five-sixteenths; that of the shank, one-eighth of an inch. It is very sharp. There seems to have been a defect in the material, which caused the sharp point of the barb to break off, and which weakened the hook itself. This came from an early site where I have gathered many articles myself, and all are clearly prehistoric. The large copper spear figured by me for Dr. Abbott's 'Primitive industries' came from the same field.

Yet I think the New-York Indians seldom used hooks. All the early references are to fishing with nets and spears; and our Indian village sites are seldom on the shores of deep lakes, almost always by streams, or near the shallow rifts of rivers. Stone fish-weirs are not uncommon, probably used as they were farther south. One of three deep bays which I measured was a work of great magnitude. Nets were much used, and I have found the flat sinkers on sites far away from the water. These were small, however. The large ones, measuring six to seven inches across, I have only found on the river-bank.

A small cylindrical sinker of brown sandstone, grooved around the centre, was probably used on a line. The ends are rounded. A rough tube of copper, two and a half inches long by three-fourths in diameter, found by the Oneida River, I have thought might have been attached to a line, as well as the polished stone plummets.

The polished slate arrows of the Seneca and Oswego rivers, and of one part of Lake Champlain, I think may prove to be fish-knives, being much like a double-bladed knife of broad form. They would have been admirable for opening and skinning fish, had savages been so fastidious. W. M. BEAUCHAMP.

The ruddy glow around the sun.

In November, 1883, at the time of the remarkable after-glows, I noticed that there was a broad, reddish ring around the sun even at mid-day. Soon after, I briefly described the appearances in *Nature*. Since then, I have constantly observed this phenomenon. The sky is very bright for about ten degrees from the sun; then comes the ruddy zone about twenty degrees wide, the deepest color being at about the natural distance of halos. My observations show that at this place there are but few days of the year when the chromatic glow is not visible; but it varies in intensity not only from day to day, but even from hour to hour. About a year ago I discovered that an increase in the depth of color preceded a fall in the temperature, and the formation, first of a structureless haze in the upper atmosphere, and, soon after, of cirrhus-clouds. At other times storms came on with no increase in the depth of color. Soon it became evident that the latter cases were when rain fell, and the general temperature was not low. Hail and sometimes snow storms were accompanied by great depth of color. During the summer of 1884, I passed several weeks in Maine. On two occasions the colored zone appeared around the sun as distinctly as it ordinarily does here. Both times the appearance of the glow was followed by violent thunder-storms, with high winds and *hail*.

While temperature would not affect the diffractive power of particles of volcanic dust directly, yet it is possible that at a low temperature the dust particles, on account of the condensation of the air, may be enough nearer to each other to give a perceptibly greater diffractive power to the mass of air in which they are suspended. But so often has an increase in the depth of the circumsolar glow preceded the formation of clouds, that it seems far more probable that the glow is caused by the precipitation of atmospheric moisture at low temperatures. If dust is involved in the process, it is probably only by its increasing the depth of color, or by its facilitating the precipitation of moisture.

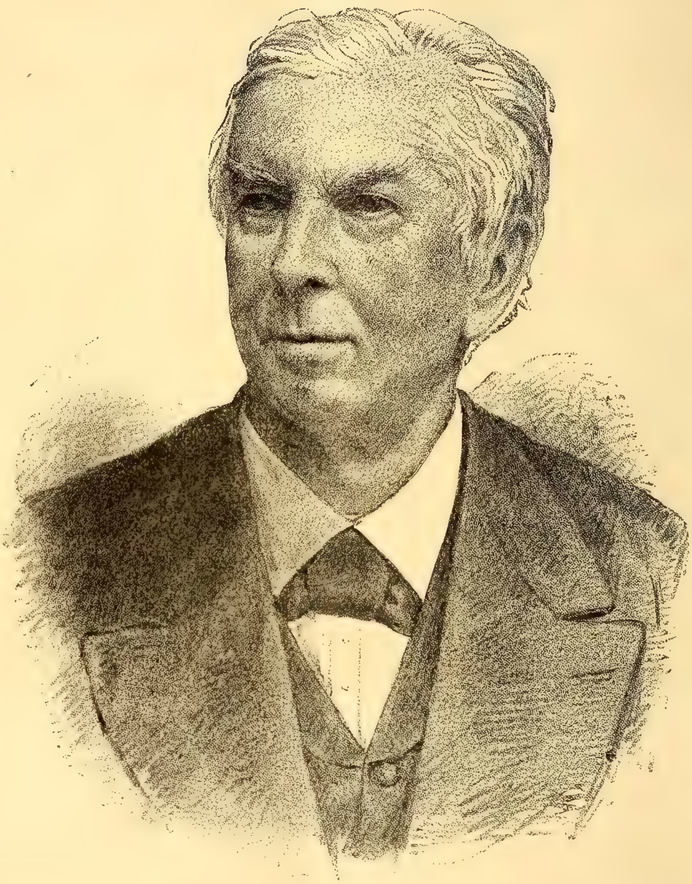
In substance, these views have been expressed verbally to numerous persons for more than a year past. They are published now not merely as a matter of theoretical meteorology, but also for a practical purpose. The observations here recorded make it probable that the glow may be utilized as a prognostication of hail. It goes without saying, that it will be of great value to many, especially to those who have much exposed glass on the roofs of green-houses, etc., to be able to predict hail and a fall in the temperature. It is true that other localities than those named may not show the same phenomena. The subject is worthy of the careful study of the signal-service, and of meteorologists generally.

G. H. STONE.

CARL THEODOR VON SIEBOLD.

THE death of Carl Theodor Ernst von Siebold, the last survivor of three distinguished brothers, deprives Germany of one of her most honored men of science. His investigations had ceased, owing to illness and the encroach-

ments of age, some time before his death; but his career is a long record of discoveries. He was born at Würzburg, Feb. 16, 1804. His elder brother, Eduard Kaspar Jakob, was a prominent obstetrician, holding a professorship at Göttingen at the time of his death. His still older cousin, Philip Franz (not a brother, as sometimes stated), became distinguished by his very successful scientific journeys in Japan and the Indian Archipelago. Carl Theodor, like Helmholz, and many another of the older German men of science, was educated as a physician, and began life with the practice of his profession, at first in a governmental post as a 'kreis-physikus' in Heilsberg for a year, next as director of the lying-in hospital at Dantzig. In 1840 he definitely entered upon a university career as professor of physiology at Erlangen; and, after several changes, he went to Munich in 1853, and there remained until his death, on the 7th of last April.

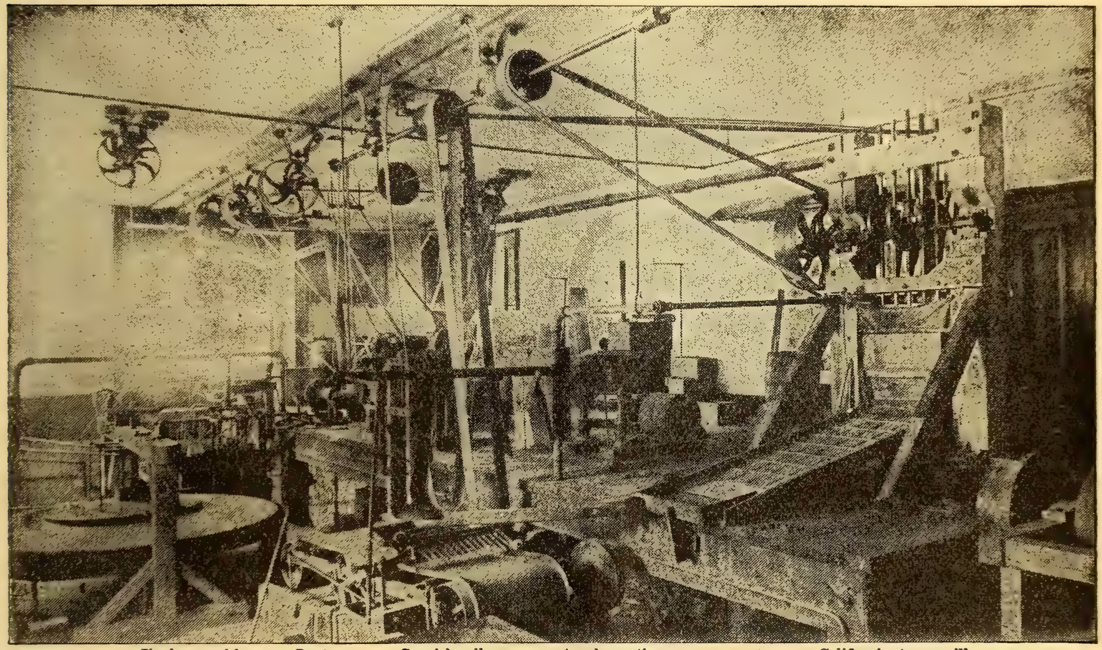


His original work has been almost entirely in the field of zoölogy, more especially in the domain of comparative anatomy. His manual of this last-mentioned science is a great masterpiece, a model of truthful and critical compilation, supported by numerous original observations. In this work an immense array of facts are properly co-ordinated, and the whole concisely presented. It is not too much to say of this publication, that it has never been surpassed as an adequate exposition of the contemporary knowledge of comparative anatomy. Siebold's own investigations have been very numerous. His researches on the development of the intestinal worms, and also those on parthenogenesis, opened new fields of thought, and the first-mentioned were of great practical utility to mankind. His monograph on the fresh-water fishes of Europe is the standard authority on the subject. Together with Kölliker, he founded the famous *Zeitschrift für wissenschaftliche zoologie*, a journal of the very highest character. The museum at Munich, of which he had charge, is a beautiful monument to his scientific and judicious administration. Such, in brief, are the long-continued and successful labors of one of the most esteemed veterans of German science, of one whose work and influence have contributed much to give Germany of to-day the intellectual leadership of mankind.

THE NEW MINING LABORATORY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

BEFORE the era of railroads there was comparatively little demand for technically educated engineers; and those who were classed as such were either self-made men, or men who, after a college course, had studied engineering from a special liking for the profession. This process of selection brought forward many of the best engineers the world has ever seen; but the time of preparation for work extended over a period of some six to eight years. The almost incredibly rapid development of the railroad and of manufacturing and mining industries has created, within the past twenty-five years, a demand for engineers which cannot be met by the comparatively slow methods of former years. In response to this demand, schools have sprung up, most of which aim to prepare young men, by a four-years' course, to become engineers. As a natural result, there has been a rush of young men to these schools, in the expectation of finding lucrative positions open to them immediately upon graduation.

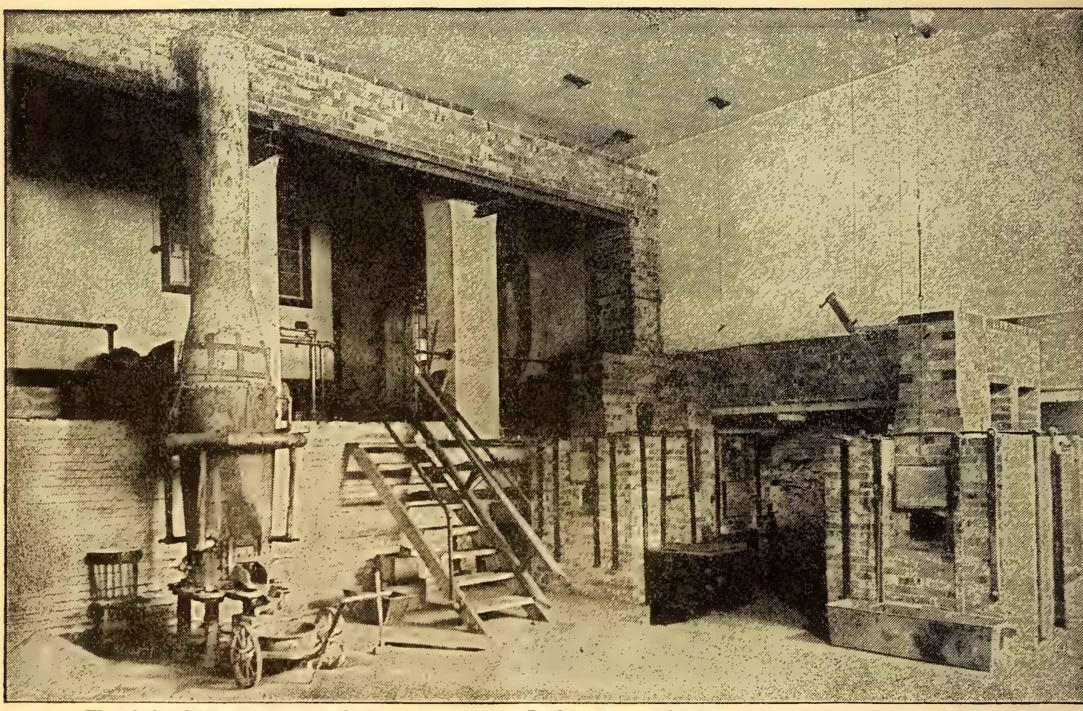
Perhaps one man in four selects a given course because he knows exactly what he wants to do. The other three have no special bent, and therefore follow their classmate's lead. The duty devolving upon the school is consequently to instruct to the best advantage the students of both classes in order that they may meet the world's demand. There is room in the field of discovery and enterprise, not only for the Siemenses, the Bessemers, and the Holleys, but for an army of intelligent managers of works and their assistants. The student who has it in him to become a Siemens or a Bessemer will educate himself, with the help of a school, or without it maybe; but the three-fourths of a given class who are to become a most important feature in the success of the works to which they go, must be aided to form a special bent for themselves.


Jigging machinery. Evans table. Dust-fan. Cornish rolls. Frue vanner. Amalgamating pan. Amalgamated copper plates. California stamp-mill. Ball mill amalgamator.

MILLING-ROOM.

The methods pursued in all the engineering courses of the Massachusetts institute of technology for accomplishing the above object are well illustrated in the department of mining engineering and metallurgy, which has recently enlarged and refitted its laboratories. The plan is to assign the maximum amount of time possible in a four-years' course to the usual mental training for the profession, including the principles of chemistry, physics, mathematics, and modern languages, — all of them subjects best learned at school, — together with an amount of laboratory-work as small

in quantity as will successfully accomplish the following purposes: namely, first, to illustrate, amplify, and explain the use and bearing of the theoretical training; and, second, by some actual experience to eradicate the conceit and superficiality which so often follows from book-knowledge only, and in this way to give the student a suitable introduction to the world. Experience shows that this course gives a student an insight into the bearing and use of much of his mental work, and serves as an initiation to his profession where competition is sharp, and only the most teachable and industrious can survive.



Water jacketed furnace for copper or lead. Slag-kettle. Lead reverberatory furnace. Lead-kettle. Copper-refining reverberatory furnace.

FURNACE-ROOM.

The new mining laboratories have an area of floor-space of between five and six thousand square feet. They are furnished with apparatus for the mechanical preparation of ores for furnace-work, for lixiviation, and for assaying, each of these subjects being assigned a separate room. The machines and furnaces are arranged in a manner which an experience of thirteen years has shown to be the best for the class-work of students. While in a large establishment it is desirable to have as many as possible of the machines run automatically, in a laboratory for instruction it is desirable, on the other hand, not to have the machines and furnaces run automatically, else the students will fail to gain the very experience which they need.

When the students begin their work on ores in the last year of their course, they are already practised analysts, having had a three-years' training in the chemical laboratories, and a course in assaying. They are already looking toward actual work in eight months' time, and they fully appreciate the opportunity given them to make a somewhat intimate acquaintance with the tools and processes of the professions they hope to follow.

A few examples of investigations which have been made will suffice for illustration. Two students were given gold ores to treat. The first one had an ore from New Hampshire weighing 4,440 pounds: the second had an ore from Nova Scotia weighing 1,400 pounds. The problem given them to solve in the case of each ore was as follows: 1. Is the ore a free-milling ore? 2. Is the gold in a fine, or coarse condition? 3. How many amalgamated plates are needed to catch the whole of the

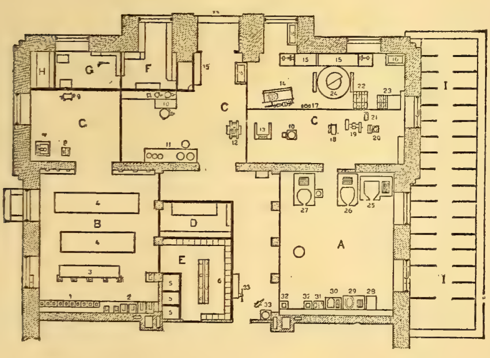
gold? 4. Will there be much waste in treating the ore? 5. If so, how much, and what means should be adopted to avoid it?

The rock was crushed fine in a stamp-mill, and the fine sand was conducted by the agency of water over a series of amalgamated copper plates, by which any active or free-milling gold was taken up, and the passive, rusty, included gold was allowed to pass on, together with the sand. This sand, before going to waste, was treated on a concentrator; and from the product or concentrate the greater part of escaped gold could have been extracted by chlorine.

The yield of gold per ton was as follows: —

	Nova-Scotia ore.	New-Hampshire ore.
	Coarse nuggets.	Very fine grains.
Gold in the amalgam of the stamp-mill	$13.040	$2.28
Gold on the first plate	0.200	1.35
Gold on the second plate	0.010	0.11
Gold on the third plate	0.030	0.09
Gold on the fourth plate	0.007	0.05
Gold on the fifth plate	0.002	0.03
Gold in the concentrates	0.150	0.37
Gold on the additional mercury trap	–	0.02

From these experiments the students ascertained that the Nova-Scotia gold is very coarse, is almost all saved in the stamp-mill, and less



A, furnace-room; B, assay-room; C, milling-room; D, supply-room; E, toilet-room; F, private laboratory; G, office; H, balance-room; I, vaults; J, entrance to vaults.

than five plates will answer for treatment, and that the concentrates yield very little additional gold; while New-Hampshire gold is quite fine, is not much more than half saved in the stamp-mill, that five plates are not enough, and if the series were continued to eight or ten the last would probably more than pay for itself, and that considerable gold is saved in the concentrates.

A third student had a lot of galena weighing one ton to treat for lead, silver, and gold. Aided by his classmates, he crushed the ore, sampled, calcined, sintered, and smelted it, obtaining base bullion. He extracted the gold and silver by the zinc process, followed by cupellation. The silver-gold brick obtained was carefully valued, as were also all his products throughout the test. The losses in the process were, —

	Per cent.	*Per cent.*	*Per cent.*
In calcining	Lead, 5.	Silver, 2.	Gold, 0.
In smelting	Lead, 12.	Silver, 7.	Gold, 4.
In cupelling	Lead, 8.	Silver, 6.	Gold, 1.
Total losses	Lead, 25.	Silver, 15.	Gold, 5.

From the results, not only did he learn with his own hands and eyes where the greatest difficulties are to be encountered in lead and silver smelting, but also the familiarity with this process rendered his reading upon the smelting of copper, iron, and other metals, far more intelligible and real.

When work by day only is called for, there is enough of the spirit of investigation in nearly every student to carry him over the tedious part of his task for the sake of the results he sees immediately within reach. When the test lasts through the night also, as happens three or four times during the year, there is always enough of the savor of camping out to help keep up the interest.

SILVER FROM A PENNSYLVANIA MOUND.

SITUATED near the town of Irvine, Warren county, Penn., on a very pretty and fertile bottom of the Alleghany valley, are two mounds, well known for the last seventy years. No opening had been made in either in this time, except a shallow pit dug in the side of the smaller about fifty years ago. While spending a few days last summer in that region, I obtained permission of the very intelligent and courteous owner, Dr. William A. Irvine, to make a thorough exploration of them.

The smaller, which is on the bank of the river, near the point where it is joined by the Brokenstraw Creek, is circular, fifty-two feet in diameter, and three feet and a half high, but has evidently been considerably lowered and expanded by the plough, as the land has been under cultivation for at least sixty years,

and for some time previous thereto was occupied by a band of Seneca Indians.

The chief features of this mound, as shown in fig. 1, which represents a vertical section of it, are the pit and large central stone vault (No. 1). The former was found to be two and a half feet deep below the natural surface-line, *ab*, and about forty feet in diameter, the diameter probably indicating the original extent of the mound.

The upper portion of the vault had fallen in, wedging the stones so tightly together that it was somewhat difficult to remove them; but the original form and mode of construction could easily be made out without the aid of imagination, as the lower portion was undisturbed. The builders had evidently miscalculated the proportions necessary for stability; as the diameter, from outside to outside, was fifteen feet, though the walls were very thick near the base, while the height could not have exceeded seven feet: hence it is probable that it had fallen in soon after the dirt was thrown over it. The stones of which it was built were obtained in part from the bed of the neighboring stream, and partly from a bluff about half a mile distant, and were of rather large size; many of them being, singly, a good load for two men.

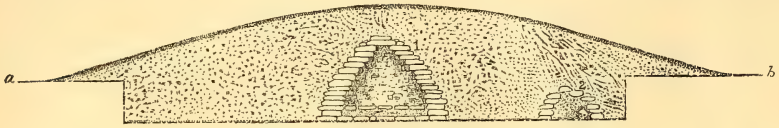


FIG. 1. — SECTION OF MOUND NEAR IRVINE, PENN.

The bottom was formed of two layers of flat stones, separated by an intermediate layer of sand, charcoal, and remains, five inches thick (at the time it was excavated). It was apparent that these layers had not been disturbed, save by the pressure of the superincumbent mass, since they were placed there. The intermediate layer was composed in great part of decomposed or finely pulverized charcoal. In this were found the teeth, decaying jaws, a single femur, and a few minute, badly decayed fragments of the bones of an adult individual, and with these the joint of a large reed or cane, wrapped in thin, evenly-hammered *silver-foil*. The latter had been wrapped in soft, spongy bark of some kind, and this coated over thickly with mud or soft clay. The weight of the stones was so great that the femur was found pressed into a flat strip, and the reed split. I was unable to determine certainly whether the burning had taken place in the mound or not. The few bones found did not appear to be charred, and the same was true of the cane-joint: on the other hand, the bark, although wrapped in clay, was very distinctly charred.

A careful analysis of the metal-foil has been made by Professor Clark, the chemist of the geological bureau, who pronounces it comparatively pure native silver, containing no alloy. Although wrapped around the cane, a portion of it appears to have been cut into small pieces of various shapes, two of which are represented in fig. 2, *a* and *b*. Where the margins remain uninjured, they are smoothly and evenly cut. The joint of cane which has been taken between the nodes is nine inches long, and must have been about an inch in diameter. A small stone gorget was obtained from the same layer.

At No. 2, on the north-east side of the pit, were a few large stones which may have formed a rude vault, but were in such a confused condition, this being the point disturbed by the first slight excavation, that it was impossible to ascertain their original arrangement. Among them were found parts of an adult skeleton. The person who dug into the pit at this point, finding human remains, stopped work, and refilled the opening he had made.

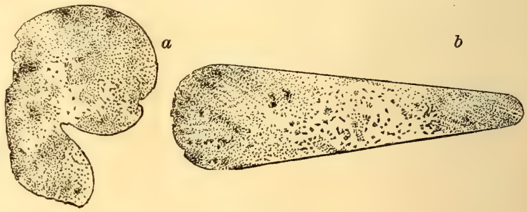


FIG. 2.

The Senecas, as I am informed by Dr. Irvine, who has resided here since 1822, protested that they did not know who built these mounds; which statement seems to be borne out by the fact that intrusive burials, probably of their dead, were discovered in the other tumulus.

CYRUS THOMAS.

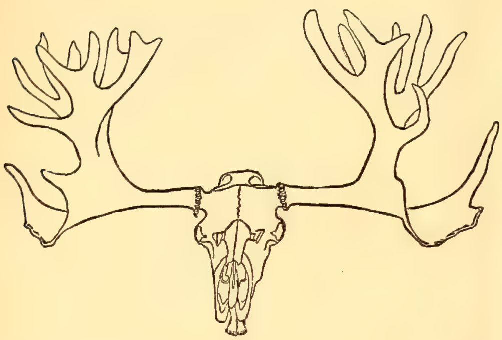
A FOSSIL ELK OR MOOSE FROM THE QUATERNARY OF NEW JERSEY.

LAST summer Rev. A. A. Haines presented to the museum of Princeton college a remarkably perfect skeleton of a large elk or moose,

SKELETON OF CERVALCES. SCALE IS GIVEN IN FEET AND TENTHS.

found in a shell-marl beneath a bog, in Warren county, N.J. In all probability, this animal belongs to the same species as the specimen from the Big-Bone Lick, Kentucky, described by Wistar as a species of Cervus (*Proc. Amer. phil. soc.*, 1818, p. 376), and named Cervus americanus by Harlan in 1825. This specimen, which is now in the museum of the Philadel-

phia academy, consists of a broken cranium, some fragments of antlers, and two metacarpals. Assuming the correctness of this identification, a very short examination of the Princeton skeleton suffices to show that the species in question is most distinctly not a Cervus at all, but is much more like an Alces. It is, however, sufficiently different from the last-named form to necessitate the formation of a new genus for its reception. For this I have proposed the name Cervalces, which serves to indicate its relationship. The specific name given by Harlan must, of course, be retained, so that the full name will be Cervalces americanus.



HEAD OF CERVALCES FROM THE FRONT, REDUCED 1-25.

Cervalces was a very large animal, with large head, short neck and trunk, and exceedingly long legs (much longer than in the great Irish deer). The antlers are palmated, though far less so than in the moose, as in that form they have horizontal beams, no brow-antlers, and a dichotomous division of the tines; but they do possess, as the moose-antler does not, a bezantler, and a posterior tine given off from the beam opposite to it. These processes occur in the antlers of Dama (the fallow deer) and Megaceros (the extinct Irish deer). In Cervalces the two tines named are connected by a flaring process of bone, which descends below the level of the eye, and present a most peculiar type of antler, altogether different from any thing known in any member of the deer tribe.

The nasal bones are much longer, and the nostrils much smaller, than in the moose, showing that there was no such proboscis-like snout as in that animal. The premaxillae are shaped as in the stag, and join the nasals. The skull is broader and shorter than in the moose, and in many respects like that of the true deer. There are also cervine features in many parts of the skeleton, together with peculiar characters. Cervalces agrees with the moose, and differs from the stags, in having the lower ends of the lateral metacarpals present (Telemetacarpalia of Brooke).

Altogether, the fossil gives us much welcome light on the obscure relationships of the moose to the other members of the deer family, showing that that curious form was derived from a type very like Cervus, but having the lateral metacarpals complete throughout. Cervalces is not one of the steps of direct descent, but it shows what that descent must have been.

It is certainly a very remarkable fact that an animal which in quaternary times was probably most abundant in this country should be represented in the collections by only two specimens. The superb specimen at Princeton is practically a perfect skeleton; for, except two or three caudal vertebrae, the few missing bones are represented by their fellows of the opposite side. The skeleton has been most skilfully restored and mounted by Curator F. C. Hill. A full description, with plates, will shortly appear in the Proceedings of the Philadelphia academy. W. B. Scott.

Geological museum, Princeton, N.J.

GEOGRAPHICAL NEWS.

Rev. William E. Fay of the west central African mission contributes three small maps of the route between Benguela and Bihé to the *Missionary herald.* The trail was surveyed with a prismatic compass, the distances determined by the pedometer, and altitudes along the line checked by observations for the boiling-point. The route was passed over four times; and the maps, while confessedly approximations only, form a distinct advance over the reconnoissance made by Cameron, which, up to the present time, has been the only authority for this region. The new sketches cover an area about sixty miles wide north and south, and extending some four degrees in longitude. The changes of scenery between Benguela and the interior are numerous and striking. First, the route passes along the level sands of the coast, under a tropical sun. From Catumbella it strikes inland, ascending the highlands at once, and traversing a rocky desert which separates the coast from the fertile lands beyond, rich in tropical verdure. Still ascending, the well-remembered features of the temperate zone are seen on every side. Descending, at the eastern foot of the range are the first human habitations. About one hundred miles from the coast, the Bailombo River, in wet seasons, is spanned by a native bridge, whose builders take toll, as in more civilized lands. The mission village lies in about east longitude 16°, and south latitude 12° 15′, south-east from the *ombola* of Kwikwi, ruler of the Bailundu region. This is a broad and beautiful valley, densely populated, and lying eastward from a

region of mountains estimated to rise in peaks of from five to eight thousand feet, the source of numerous important rivers, whose mouths are often separated by great distances, and whose courses trend to almost every point of the compass, from the mountain reservoirs where they take origin.

Late advices from Zanzibar state that the four explorers sent to the Ussagara by the German colonization society have been very unfortunate. They halted between Mpuapua and Condoa, where one died. Dr. Peters and Herr Baumann, stricken with malignant fevers, were obliged to return to Zanzibar in a serious state, while the leader of the party was left alone on the spot in a condition of great destitution. Aid was immediately despatched by the German traders of Zanzibar, which, it is hoped, will ameliorate his condition.

Two other German explorers, the brothers Denhart, sent by the Berlin geographical society, had arrived at Zanzibar, where they were joined by Herr Schlumke, for the last five years an explorer with Dr. Fischer.

The party intend to visit Samburo Lake, and explore the region of the Borani Gallas, as well as to explore the geology and botany of the upper parts of Kilimanjaro and Kenia.

The death of King Mtesa is confirmed. Those interested in the civilization of the country believe his successor will be more likely to assist in the process than the late king, whose volatility and caprice more than undid the good resulting from his occasional favors. Mirambo, sometimes known as the negro Napoleon, is also dead. He was noted for his courage, great intelligence, and semi-civilization. His death is likely to plunge the population of a vast region into anarchy; for by his ability, in spite of his humble birth, he had brought into submission a large territory, and made all the neighboring sultans his vassals.

The Algerian fathers have selected a healthy spot for their mission on the west bank of Lake Tanganyika, at a village called Chonsa, in about latitude 7° 30′. The natives are friendly, and the country a safe one.

Lieut. Becker's expedition had not started, and the difficulty of getting a sufficient number of porters was very great. This seemed due to the famine, which continues to desolate the interior, and to the uncertainties connected with matters in the basin of the Kongo.

A rumor has reached Paris through Bolivia, from the Gran Chaco region, that certain country-people, travellers in the interior, had found in the forest bits of paper and linen on which one of the Crevaux party had written his name in blood, together with an appeal for succor, and the statement that he had been spared by the Tobas on account of his skill as a musician, and had been obliged to follow the band which held him captive in all their wanderings since the massacre. The story, which has found a place in the printed proceedings of the geographical society of Paris, is, nevertheless, probably an invention of the 'travellers in the interior.'

An important journey has recently been made by a party commanded by Feilberg on behalf of the Argentine Confederation. Their object was to explore the trade-route between that country and Bolivia *via* the Pilcomayo. They comprised sixty-two men, with flatboats towed by two small steamers, and were absent fifty-five days. The actual distance in a direct line was probably forty-five leagues; but, taking the sinuosities of the river into account, the party travelled about eighty leagues. Up to this point, the navigation was not bad except for snags and sunken tree-trunks in the channel, but here it became impossible on account of a series of rapids which descend over a rocky surface with only a few inches of water, though the river was in flood. The question of a trade-route by this way is therefore definitely settled in the negative. The party found that below the rapids, sixty leagues above the mouth, a large affluent came into the Pilcomayo, with as much water, or perhaps even more, but which is not found on any chart. It was obstructed by sunken trees, but otherwise showed no impediments, and was ascended for twelve leagues. Feilberg hopes to explore it farther. The country along these rivers appeared healthy, and rich with fine pasturage. It appears now to be certain that the only feasible trade-route will be one carried overland.

THE AMERICAN FISHERIES SOCIETY.

The fourteenth annual meeting of this society was held in the lecture-room of the National museum at Washington, May 5–7; the president of the society, Hon. Theodore Lyman, in the chair. The attendance throughout was fair, and the papers were, for the most part, exceedingly interesting. The roll of membership now includes about a hundred and fifty names, twenty-four new members having been elected during the meeting.

Prof. R. E. C. Stearns read a paper on the giant clams of Puget Sound. He referred to Glycimeris generosa as the 'boss clam' of North America. It was first described by Dr. Augustus A. Gould from specimens (probably of the shells only) obtained by the Wilkes exploring expedition, 1838–42. The distribution of this clam extends southerly along the west coast of America to San Diego, where it has been found by Mr. Hemphill; and it is more abundant in its northern than in its southern habitat. It is an excellent article of food, and is called by the Indians *geoduck*. It has been known to attain a weight of sixteen pounds, and a length of from one and a half to two feet.

A paper by Dr. James A. Henshall, on the hibernation of the black bass, was read by Mr. Mather. The writer advanced the theory that hibernation was a voluntary act, and did not necessarily involve a state of profound torpidity. He admitted that other fish were active in the same waters where black bass were hibernating, but accounted for this by saying that there was no supply of food for the bass. In the

extreme south, where crawfish were abundant, it did not hibernate; so that he considered hibernation to be the result of lack of food, rather than of temperature. Mr. Goode, in discussing this paper, regarded hibernation as purely a matter of physical cause and effect, holding that the hibernation or non-hibernation of the black bass in a given latitude depended entirely upon the temperature of the warmer retreats accessible to the fish. Black bass always hibernate in shallow bodies of water in cold climates.

Mr. Fred. Mather, in a paper on smelt-hatching, gave an account of some experiments in hatching the smelt Osmerus mordax, which seemed to indicate that quiet, almost stagnant water, and the presence of slime and fungus, were beneficial rather than detrimental to the proper and rapid development of the eggs.

Mr. F. W. True read a paper on the porpoise fishery of Cape Hatteras. This fishery was regarded as in its infancy in this country, and capable of great development if the animal could be taken in sufficient quantities to secure the introduction of its oil and leather into the markets. The company recently formed at Cape Hatteras by a party of Philadelphia capitalists hoped to utilize the meat of the porpoise for food. It is estimated, that, at the close of the present season, not less than four thousand porpoises would have been captured by this company. Mr. Goode thought, that, if the flesh could in some way be divested of its oily taste, it might be a very palatable article of food. He had while in London, in 1883, tasted some whale-flesh (put up in Norway in hermetically sealed cans), and spoke of its resemblance in flavor to beef *à la mode.* The oil he considered superior, for lubricating-purposes, to any other animal oil, but thought that its present high price would prevent it from coming into general use. He also said that in Europe boots made from porpoise leather were held in high esteem, and cost from fifteen to twenty dollars a pair. He considered the leather as most desirable for belting and lacing purposes. Mr. Lyman expressed his belief that the products of the porpoise fishery might be made of considerable commercial value, provided the animal could be taken in sufficient quantities.

Mr. Frank N. Clark gave some results of artificial propagation and planting of white-fish in the Great Lakes.

Mr. A. Nelson Cheney submitted a paper entitled 'Does transplanting affect the food or game qualities of certain fishes?' This was followed by a paper by Mr. J. S. Van Cleef, on 'How to restore our trout-streams.'

Dr. Tarleton H. Bean exhibited a nearly complete series of salmon and trout of North America, showed a species of Oncorhyncus, Salmo, and Salvelinus. He said that the species could be, for the most part, very well identified by a single character. In the genus Oncorhyncus, O. chouicha might be known by its very large number of branchiostegal rays, and the numerous pyloric coeca; O. nerka, by its large number of gill-rakers, usually about forty; while none of the other species have more than twenty-seven. O. kisutch has but few pyloric coeca, — seventy to eighty. O. gorbuscha has very small scales; so much smaller than any other species of this genus, that this character alone will suffice to distinguish it. O. keta, the last species, resembles O. chouicha in most respects, but has a smaller number of branchiostegal rays.

The species of Salmo are easily divided into two groups, one of which has hyoid teeth, the other having none. Of the first group there are two small-scaled species, — S. Gairdneri; and its fresh-water form irideus, in which the scales are never in more than a hundred and fifty longitudinal rows. The small-scaled form S. spilurus, with its offshoot S. pleuriticus, has sometimes as many as two hundred scales in the longitudinal series. The group with hyoid teeth includes Clark's trout, S. purpuratus, with its varieties, Bouvieri, stomias, and Henshawi.

The species of Salvelinus divide themselves into two great groups, the first of which has a tooth-bearing crest on the vomer. This is represented by namaycush and its variety siscowet. All of the other Salvelini are red-spotted, and have no crest on the vomer. These are again divided into two great classes, one having hyoid teeth, and the other having none. The Salvelini with hyoid teeth are oquassa, naresi (which is a near relative of oquassa), arcturus (the most northerly salmonoid known), malma, the Pacific red-spotted char, and salvelinus (which has been introduced into New England from Bavaria). The group without hyoid teeth includes fontinalis, known in the searun condition as immaculatus, and in its northern habitat varying into hudsonicus of Suckley. It is a giant in this genus, reaching a weight of fifteen pounds. This Labrador form has a larger number of gill-rakers than the common fontinalis, and there seem to be fewer tubes in the lateral line; so that we may be obliged to consider it as a species distinct from fontinalis. The last species of this group is S. stagnalis, a Greenland species, which reaches a large size, and is distinguished by its greatly elongate form.

The three species recently introduced from Europe into America are Salvelinus salvelinus (already mentioned), Salmo levenensis (the Loch Leven trout of southern Scotland and northern England), and Salmo fario (the river-trout of central and northern Europe and England).

The species of Salvelinus, both eastern and western, attain their greatest development in the northern portion of their habitat. Thus the S. malma of the west coast is represented in the national museum by examples more than two feet in length from Alaska; and the Labrador form of the eastern brook-trout bears more resemblance in size to a Maine salmon than to any thing else. Another noticeable fact about our salmonoids is that almost all of the western forms are black-spotted, while all but one of the indigenous eastern forms are red-spotted.

Col. McDonald, in a discussion of the 'Objective points in fish-culture,' presented an argument for a more extended application of the methods of scientific research, showing how exceedingly valuable to fish-

culture would be a more perfect knowledge of embryology, of the physical conditions of the waters, and the influence of temperature upon the movements of fish, etc.

Mr. W. V. Cox gave the audience a 'Glance at Billingsgate,' describing the location and general arrangement of this celebrated fish-market, and the daily methods of transacting business. He called attention to the fact that there was a great need for the introduction of a system of cold storage similar to that employed in the United States.

Mr. Fred. Mather gave an account of his work at Cold Spring Harbor. Statistics were presented showing the numbers of the various species hatched out under his direction, and a brief explanation as to his methods of operation was added.

Mr. Eugene S. Blackford read a paper on the oyster-beds of New York, containing a very instructive account of the present condition of the oyster industry of New York. In the course of his remarks, it was made to appear that the supply of oysters was much greater at present than ten or twelve years ago, and that, by a careful continuance of the methods of protection and planting, there was not the slightest doubt that the most successful oyster industry in the world would become developed in the waters of Long Island Sound.

Mr. John A. Ryder presented a paper on some of the protective contrivances developed by, and in connection with, the ova of various species of fishes. He classified the eggs of fishes into four divisions, — 'buoyant,' 'adhesive,' 'suspended,' and 'transported;' this last including such eggs as are hatched in the mouth, or in receptacles especially developed on the outside of the abdomen, or under the tail of the parent fish (usually the male), such as are hatched in nests built by the males, or are viviparously developed in the ovary or the oviduct of the mother. The egg of the cod was the type of the first division, buoyant, but without an oil-drop. The egg of the Spanish mackerel, bonito, cusk, and many other marine fishes, is buoyant, and with an oil-drop opposite the germinal pole, where the embryo develops. The second group was represented by the egg of the goldfish, which adheres singly to plants and weeds. The blennies lay eggs in radiating, adherent groups. The gobies, gobieso, yellowpeids, and many other forms, belong to this group. As an example of 'suspended' eggs, he referred to the common oviparous ray, which has four filamentous horns, one at each corner, which wind around plants, and suspend the eggs to weeds; so that as the tide sweeps by these horns, which have openings in them, fresh water is carried into the egg-case to aerate the embryo, and favor its incubation. In the Scombresocidae the entire egg-membrane is covered with strong filaments, which intertwine with those of contiguous eggs; and thus masses of eggs are suspended, sometimes several inches in length. The Apeltes, or four-spined stickleback, was cited as an example of the fourth group. The male has a pouch on the right side of the rectum, from which is poured out a viscid secretion, and which is spun out into threads fitfully by the animal, as he goes round a bunch of waterweeds, like a bobbin, to build a little basket-like nest for the eggs. Callichthys also builds a nest, while Antennarius and fishing-frogs of the deeper ocean deposit their eggs on masses of sargossa-weed. Reference was made to the number of salmonoids that prepare beds for the better protection of their eggs. This was also done by the black bass, sun-perch, and lampreys.

Prof. O. T. Mason, in a paper describing the use of the throwing-stick by the Eskimo in fishing, said that the most interesting of modern ethnological studies is the tracing of human arts from their birth through the different stages of their evolution. Many savage devices live on in civilization; but there is one, the Eskimo throwing-stick, which is not only one of the most ingenious of aboriginal devices, but one which has not survived in more highly cultured peoples. An account was then given of the manufacture, use, and distribution of this implement.

Professor Theodore Gill presented a paper entitled 'The chief characteristics of the North-American fish fauna.' He restricted his remarks to the fresh-water forms alone. He described America north of Mexico as a primary, terrestrial-aquatic realm, variously designated as the North-American, nearctic, and Anglogaean region or realm. It is one of the very richest in fresh-water types, more than six hundred species living exclusively, or nearly so, in the rivers and lakes. These species represent a hundred and fifty genera, and about thirty-five families. The North-American fish fauna may be segregated into two primary categories: 1°, arctogaean, including those families which are shared with Europe and northern Asia; and, 2°, those peculiar to this continent, which are the Amiidae, Hyodontidae, Percopsidae, Amblyopsidae, Aphredoderidae, Elassomidae, Centrarchidae, and several sub-families, as the Etheostominae, Hoplodinotinae, and Hysterocarpinae. Of the fresh-water species and genera of most of the families, some are anadromous; others inhabit salt and fresh water almost indifferently; and still others are catadromous, as the eel, which appears to breed only in the sea. The number of genera common to Europe and North America is extremely small. It is noteworthy that the number of the types peculiar to America are distinguished by the care which the parents take of their young, whereas the European forms are generally indifferent. The care of the eggs and young seems to be accompanied by an apparent diminution of the number of eggs; and in this respect there is a kind of analogy between fish-culturists and parents. The fish-culturists assume the part which, in nature, is exercised by the attentive parent; and the eggs and young, being provided for, stand less danger of destruction, and consequently in such the ratio between the eggs laid and fertilized, and the young matured, is very much less than that between the number of eggs of indifferent parents, and that of other progeny matured.

On Thursday, at noon, the members of the society, through the courtesy of Professor Baird, went on the U. S. fish-commission steamer Fish-hawk, for a trip down the Potomac River, to visit the shad-hatching

station at Fort Washington, and some of the Potomac fishing-shores. Col. McDonald, in charge of the fish-hatching station, displayed the apparatus for, and explained the process of, hatching shad and herring eggs at all the various stages. After the roe is taken from the fish and cleaned, it is put into glass tanks, through which the water is allowed to flow constantly. About forty-eight hours are required to hatch out the eggs. A shad a day old looks like a hair with two black spots attached to the end. When two days old, they measure about one-fourth of an inch in length. In twelve days the whole body is distinguishable. The spawn are not, as a rule, kept at this hatching-station more than thirty-six hours; at the end of which time, just previous to hatching, the eggs are placed in crates, and brought to the principal station at the armory building, near the national museum, where the final stages of incubation occur. The commission has this year hatched five million shad-eggs. The herring yield has been much larger, as the catch of this fish in the Potomac has been unusually abundant; nor are so many eggs of the herring destroyed during the process of hatching as of shad. The commission employs eighteen men at Fort Washington, who are constantly kept busy preparing the spawn and eggs for transportation. The day before the party visited this station, sixty thousand shad-eggs were taken. After the hatching process had been explained to the visitors, they were summoned to refreshments, which had been provided in one of the frame buildings belonging to the commission. The principal dish was 'planked' shad. By this process four fish are fastened to a board, and held towards a hot fire. Whilst cooking, the fish are constantly basted with a preparation made of butter, salt, and other ingredients. At a meeting on board the vessel, the commissioner of agriculture made some remarks on fish-culture in the west, and Col. Marshall McDonald offered an address on our fishing interests in general, and the work of the society in particular.

The following officers were elected for the present year. President, Col. Marshall McDonald, Washington. Vice-president, Dr. William M. Hudson, Hartford, Conn. Treasurer, Eugene G. Blackford, New York. Corresponding secretary, W. V. Cox, Ohio. Recording secretary, Fred. Mather, New York. Executive committee, G. Brown Goode, Washington; F. L. May, Fremont, Neb.; Roland Redmond, New York; J. A. Henshall, Cynthiana, Ky.; Frank N. Clark, Northville, Mich.; S. G. Worth, Raleigh, N.C.; George Shepard Page, Stanley, N.J.

INLAND NAVIGATION OF EUROPE.[1]

THE lower parts of the chief rivers of the United Kingdom are mostly arms of the sea, navigable at high water by ships of the largest burden. The principal waterway, the Thames, is navigable for about 194 miles, and is united by means of a grand network of canals with the Solent, the Severn, the Mersey, the Humber, and the Trent, being thus in direct communication not only with the English and Irish channels, but also with every inland town of importance south of the Tees. The estimated length of inland waterways in the United Kingdom is 5,442 miles, which has been constructed at a cost of £19,145,866.

Russia's principal highway is the Volga, the largest river in Europe, which affords, with its tributaries, 7,200 miles of navigation. Hitherto no permanent works have been undertaken to improve the navigation of the Volga, but dredging has been resorted to in the lower part of the stream; and recently a system of scraping by iron harrows has been employed, which has doubled the depth of water over certain shoals in a few days. Other important water communications in Russia are the Caspian; the River Don, 980 miles in length; and the Dnieper, with a course of 1,060 miles. Of secondary rivers, the Bug, the Dniester, the Duna, and the Neva are all navigable. In the case of the latter short but most important means of communication, a maritime canal 18 miles in length has recently been completed to unite Cronstadt with St. Petersburg. About 900 miles of canal have been constructed in European Russia. In most instances they have been built to connect the head waters of rivers which had their outlets at opposite extremities of the continent.

Sweden abounds with lakes; but none of the rivers are navigable except those which have been made so artificially, nearly all of them being obstructed by cataracts and rapids. Nevertheless, Sweden possesses remarkable facilities for internal navigation during the seven months that the country is free from ice, intercourse being carried on by means of a series of lakes, rivers, and bays connected by more than 300 miles of canals.

Germany owns parts of seven river-valleys, and three large coast-streams. Of these, the Weser is the only one which belongs wholly to Germany, while of the Danube but one-fifth part runs through her territory. The inland navigation of Germany is of the most advanced character, an immense trade being carried on by means of barges and rafts. In the case of the Elbe, the system of towing by submerged cable has taken a large development. As early as 1866 chain-tugs were running on 200 miles of its course; and in 1874 this mode of traction had been so increased that there were then twenty-eight tugs running regularly between Hamburg and Aussig. These tugs are 138 to 150 feet long, 24 feet wide, with 18 inches draught. On the upper Elbe the average tow is from four to eight large barges, and, taking the ice into consideration, there are about three hundred towing-days in the year. Although Germany possesses a length of nearly 17,000 miles of navigable rivers, or more than double the combined length of the navigable streams of the United Kingdom and France, it cannot be said to be rich in canals. In South Germany the Regnitz and Ludwig canals, from the Main at Bamberg to the Danube, were the only ones of importance until the annexation of Alsace-Lorraine.

[1] From a lecture by Sir C. A. HARTLEY before the Institution of civil engineers.

Holland possesses the great advantage of holding the mouths of the Rhine, the Maas, and the Scheldt. Her means of river communication with Germany, France, and Belgium, are unbounded; and the possession of a length of 930 miles of canals and 340 miles of rivers enables her, apart from her railways, to carry on her large trade with greater facility of transport than, perhaps, any other European country.

Belgium shares with her northern neighbor the advantages of an elaborate system of waterways. By far the most important river is the Scheldt. Thanks to its unique position at the head of a tidal estuary, to the abolition of the Scheldt dues, and to the foresight and liberality of the Belgian government, which has spent $20,000,000 on dock and river works since 1877, Antwerp has now become in many respects the foremost port of the continent. Besides her 700 miles of navigable rivers, Belgium possesses about 540 miles of canals, by means of which communication exists between all the large towns and chief seaports of the kingdom.

France has built up, and is constantly extending, an elaborate system of canals and canalized rivers. Of the latter, the Seine is the most important in regard to the artificial works undertaken for its improvement, and for the tonnage of the traffic, which was in 1872 more than one-eighth of the whole waterborne traffic of France. The Loire, the Garonne, and the Rhone have all been largely benefited by the art of the engineer. The canal system of France is historic; one of the earliest of these artificial cuts being the celebrated canal of Languedoc, 171 miles long, built in 1667–81, and now forming part of the Canal du Midi. From its summit-level 600 feet above the sea, it communicates with the Garonne, and therefore with the Atlantic, by twenty-six locks, while its southern slope descends by seventy-three locks to the Mediterranean. Up to 1878, on 7,069 miles of waterways, France had spent upwards of $215,000,000. Nevertheless, it is intended still further to extend this means of communication at an estimated further cost of $200,000,000.

Spain and Portugal possess, partly in common, eight principal rivers, of which five — the Minho, Douro, Tagus, Guadiana, and Guadalquivir — drain the western valleys, and flow into the Atlantic; while the other three — the Ebro, Incar, and Segura — discharge into the Mediterranean. As a rule, these rivers are only navigable for a limited portion of their course, and are chiefly remarkable for extremes of flood-discharge; a velocity of sixteen knots an hour having been noted in the Douro under certain conditions of tide. The canals of the Iberian peninsula are unimportant. Spain possessed a length of 130 miles in 1875.

Italy is not rich in waterways except in the valley of the Po, the navigable portion of her rivers only attaining an aggregate length of 1,100 miles. Although the total length of navigable canals in Italy is only 435 miles, the Italians were the first people of modern Europe that attempted to plan and execute such artificial waterways. As a rule, however, they have been principally undertaken for the purposes of irrigation.

Austria-Hungary possesses in the Danube the largest river in Europe as regards the volume of discharge, although it is inferior to the Volga in the length of its course and the area of its basin. This great stream first becomes navigable for flat-bottomed boats at Ulm, 130 miles from its source. In its total length of 1,750 miles, it is fed by at least 300 tributaries, many of them large rivers. Although the Danube between Vienna and Old Moldova had been regulated in numerous places and at great cost, there had been but little appreciable improvement effected in its general navigable depth. On this account, projects having in view the permanent acquisition of a sufficiently wide channel, of from six to eight feet deep at every point between Passau and Basias, have lately been prepared, which involve an outlay of $10,000,000 to effect the desired improvements. Traffic on the upper and lower Danube is mostly carried in barges, of which the greater number gauge 250 tons. The effect of the improvements at the Sulina mouth has been to increase the trade from 680,000 tons gross in 1859, to 1,530,000 gross tons in 1883, and to lower the charges on shipping from an average of five dollars per ton for lighterage, to half a dollar per register ton at the present time for commission dues. As a commentary on the hostile criticism evoked when the scheme was initiated, the lecturer drew attention to two facts; namely, that the works so unsparingly criticised in 1857 had already effected a saving of $100,000,000, and that experience had abundantly proved that the predictions of a rapid silting-up to seaward of the Sulina piers had been completely erroneous.

THE GEOLOGY OF WISCONSIN.

THE nearly simultaneous appearance of the two final volumes of the 'Geology of Wisconsin' some months since, marked the close of one of the most rapid of the state geological surveys, and, for the time and money expended, one of the most thorough and complete. The work has been done in less detail than in some other states, whose surveys have run through much longer periods of time, and have consequently necessitated much greater financial outlays. The results are embodied in four large octavo volumes, containing something more than three thousand pages. The text is well illustrated; and the judicious use of cuts, which express much more than the best verbal descriptions occupying the same space, has contributed to the embodiment of a large amount of material in relatively small compass. In the same line may be noted the predominance of observational results over theoretical deductions, and the absence of irrelevant discussions which have sometimes served to swell

Geology of Wisconsin. Professor T. C. CHAMBERLIN, chief geologist. 4 vols. Madison, Wis., 1877–83. 3,147 p., 140 pl. 8°

similar publications. The accompanying atlas sheets, more than forty in number, add much to the value of the reports.

The leading contributors are Prof. T. C. Chamberlin, chief geologist, and Messrs. R. D. Irving, Moses Strong, R. P. Whitfield, Charles E. Wright, T. B. Brooks, E. T. Sweet, L. C. Wooster, and F. H. King. In connection with lithological determinations and reports, stand the names of Irving, Wichmann, Pumpelly, Van Hise, and Julien. Vol. i. also embraces reports on selected topics in natural history, notable among which is King's report on the economic relations of our birds.

A characteristic feature of the publications is the relatively large amount of practical information brought within the reach of the intelligent citizen who has little technical knowledge of science. Indeed, the oft-repeated question of which every geologist must be weary — 'What is the object of the survey?' — would hardly be asked by one familiar with the results of the survey of Wisconsin. In vol. i. appear several chapters of economic import, the express purpose of which is to make easy of comprehension the principles which are involved in such every-day matters as the sinking of artesian wells, the manufacture of brick, tile, etc., the selection of building-stone, the relations of soil to fertilizers, where and how to search for ore-deposits, — questions concerning which the opinion of the geologist is of practical worth.

Attention has throughout been directed to known mineral resources with a view to their future development, and particularly to those formations which, from their relationship to productive mineral-bearing formations elsewhere, or for other reasons, were thought, from an economic point of view, to merit careful investigation. The benefits, both positive and negative, which have accrued to the state as the result of such investigations, have already been considerable, and will doubtless be still greater in time to come. Other natural resources have not been neglected. Attention has been directed to various building-stones of considerable merit; and some of them, in consequence, have already found their way into the market. The subject of artesian wells has received special study at the hands of the chief geologist. It is doubtful if the problem of subterranean water-supply over a commensurate area of such diversity of character is anywhere better understood.

The survey has done more than assist in the development of natural resources, and its work is to be commended for other than economic

reasons. The science of geology has received no insignificant contribution in these publications. Much light has been thrown upon some unsettled problems; and if they are still unsettled, or if their solutions are still disputed, the contribution is not less real, because the data afforded by the state are insufficient bases for positive conclusions. Each formation of the state has been carefully mapped; its stratigraphical relations determined; and its fossils, when fossils exist, identified. Ninety-four new species are described and figured, as also are some of the more characteristic forms previously known.

Among the more important and interesting results are the determinations which have been made respecting the subdivisions of the archaean formation, and those which pertain to glacial geology. Concerning the former, the Wisconsin geologists recognize three distinct groups of rocks, — the Laurentian, Huronian, and Keweenawan. These groups, it is maintained, are not only distinct, but separated by intervals which, in point of time, were of no inconsiderable duration, — intervals long enough in each case to allow profound changes, both stratigraphical and petrographical, to be accomplished during their continuance. The evidence cited in support of this subdivision, as well as that bearing on the distinctness of the Keweenawan from the Potsdam formation above, is of a positive and perfectly definite character. The greatest break is held to occur between the Laurentian and Huronian series. The rocks of the Laurentian series are much more highly metamorphosed than those of the Huronian which overlie them; they are in a highly folded and contorted state, while the Huronian rocks have suffered notably less stratigraphical distortion; the laminations of the two series, when seen in contact or proximity, are discordant; the later series contains, at its very base, material from the older highly metamorphosed rocks; and the relations of the two series to penetrating igneous rocks are such as to emphasize the conclusion to which the other lines of evidence point. Altogether, the evidence upon which the subdivision is based is strong, and, for the region under consideration, is certainly convincing. The separation of the Keweenawan rocks from the Huronian on the one hand, and from the Potsdam on the other, rests on scarcely less positive grounds. The question as to whether the Keweenawan group is to be classed as Cambrian or pre-Cambrian, is one concerning which there remains room for doubt. In any event, the important fact developed is the existence of a distinct formation younger than the Huronian, and unconformably subjacent to the oldest formation of the interior known to contain Cambrian fossils.

At the other end of the geological series equally important advances have been made. For the study of quaternary geology, Wisconsin is an exceptionally good field, because of the proximity of driftless, old-drift, and new-drift areas. The determination in 1874, of the morainic character of the previously known 'Kettle Range' of eastern Wisconsin, gave a new impetus to the study of the drift phenomena. Following this important determination was the demonstration of the character of ice-movement in a relatively level region, as exemplified by the ice which occupied the Green-Bay valley. The proof of the lobation of the ice-margin followed, and the facts and principles here first developed have been the key to the explanation of glacial phenomena since studied from the Atlantic to Dakota. The determination of hitherto unsuspected moraines, and the connection of these with each other and with moraines previously known, but not known to have more than local developments, quickly followed in the wake of the first determinations in Wisconsin. Another result, scarcely less significant, was the recognition of two clearly differentiated ice-epochs in the glacial period, separated, according to Professor Chamberlin, by an interval which may not have been less than the time which has elapsed since the last. Although the existence of two ice-epochs is not yet universally admitted, the drift phenomena of Wisconsin, especially when considered in connection with like phenomena throughout the interior, place the hypothesis upon a substantial basis. Although later investigations have slightly modified the borders of the driftless area as mapped by the survey, the reality of its existence is beyond question; and it is just as certain that between this area and that bounded by the Kettle Moraine, which marks the limit of ice advanced in the second epoch, as interpreted by Professor Chamberlin, there is an area covered with glacial drift, which, as indicated by the greater amount of erosion which it has suffered, is of much less recent origin than that within the Kettle Moraine.

The consideration of the ore-deposits of south-western Wisconsin constitutes one of the more valuable portions of the reports. The author accepts the general conclusions concerning the manner of deposition reached by Whitney some years since, but works out the

theory much more in detail, and for the first time makes it complete. For this thoroughgoing treatment of the subject by the chief geologist, the excellent topographic and geologic work of Mr. Strong prepared the way.

Wisconsin is to be congratulated upon the successful completion of a work which in so many other states has had a different issue.

NORDENSKIÖLD'S ARCTIC INVESTIGATIONS.

When Baron Nordenskiöld retired in April, 1882, from the presidency of the Royal academy of sciences at Stockholm, he took for the subject of his address the story of the Zeni brothers. This address was published in Swedish in 1883; and in the same year he laid before the Congrès des Américanistes, at their session at Copenhagen, three of the early maps, illustrative, as he thought, of an early acquaintance with Greenland, posterior to the so-called Northman discovery in the tenth century, and earlier than the period of Columbus. These were the Zeni map of 1380 (1390?); a map of 1427, found in a manuscript of Ptolemy at Nancy; and the Donis map of the edition of Ptolemy, printed at Ulm in 1482. In the German version of Nordenskiöld's papers, which has recently appeared as 'Studien und forschungen,' we have this same Zeni study in a language easier read by most inquirers. Those who believe in the substantial truth of the Zeni narrative will find Nordenskiöld on their side. He identifies the Frisland of the story with the Faröe Islands, makes the Zeni to have reached Greenland, and identifies the Estotiland and Drogeo of the Frisland fisherman with our American coast from Newfoundland south.

The botanical portion of the book has been contributed by three writers, — Nathorst, Kjellman, and Wittrock, — who treat respectively of the former botanical geography of high latitudes as indicated by the results of polar research, the biology of the arctic flora, and the vegetable life of the naked snow and ice. All of these articles are remarkably free from technicality, and form pleasant and instructive reading, the last being especially valuable because of its full references to the literature of the subject.

Fossil collections made from time to time in the arctic region, and, for the most part, elaborated by Heer, when compared among themselves, and with similar collections from Europe, show a remarkable uniformity in the early flora of the entire northern part of the world, until, scattered and driven southward along numerous lines of migration, it has left its descendants mainly on the eastern sides of the two great continents, as Dr. Gray has already shown in his history of Sequoia.

For the most part, the present arctic flora is composed of the descendants of tertiary alpine species, which, wandering from their original homes, — the Alps, the mountains of Greenland and Scandinavia, the Caucasus, and the Altai and Rocky mountains, — were driven back, at the end of the glacial period, to high elevations, or into the circumpolar region, by the warmer climate which succeeded. The collections made by the returning Vega party at Mogi, in Japan, are interesting because they indicate a certain, though relatively slight, reduction in temperature in that part of Asia corresponding to the glaciation of America and Europe, though, as is well known, no traces of inland ice occur there.

The arctic flora of to-day is a most interesting subject for study. While the ocean, at a short distance from shore, supports a growth of giant kelps and dark Florideae, which manifest continued activity the year through, vegetating in the short summer, and pushing their reproductive processes during the long winter night, the land-plants are all pygmies, apparently less because they cannot endure the intense cold of winter, than because they do not enjoy sufficient warmth in summer to assimilate enough organic matter for any considerable growth.

In a region where the average daily temperature for the least cold month of summer is but a few degrees above the freezing-point, and where vegetation is practically limited to about two months of even this slight warmth, interesting adaptations are met with on every hand. Annuals are as good as unknown, the season proving too short for the development of their vegetative organs, and the subsequent maturation of fruit. The entire flora is practically biennial or perennial; the plants rapidly pushing into bloom, like our spring flora, with the first abatement of the cold of winter, yet, unlike the latter, barely fruiting, and elaborating material for the next year's flowers before the short summer is succeeded by another winter. Indeed, the season is too short for the majority of even these precocious and hardy plants, many of which are forced to rely on vegetative reproduction except in the most favored situations, while nearly all are caught in the midst of flowering by the cold of autumn, which

Studien und forschungen veranlasst durch meine reisen im hohen norden. Von A. E. Nordenskiöld. Autoriste ausgabe. Leipzig, *Brockhaus*, 1885. 9+521 p., illustr., 8 pl., and maps. 8°.

blights them as a sudden frost nips the tender exotics of our gardens.

Yet, despite the desolation of the land in all save the most congenial localities, and the difficulty with which the plants growing in these perform their necessary functions, even the bare ice and snow are not without their life, no less than forty-two species or well-marked varieties of ice and snow plants being now known. As might be inferred from their habitat, these are mainly algae, though the alga-like protonemata of several mosses are found, and the occurrence of putrefaction to a slight extent argues the presence of bacteria. The essential characters of this flora, are, in brief, that it consists almost exclusively of water-plants of low organization, propagating themselves chiefly by non-sexual processes. These plants are all microscopic; yet, as they are for the most part brightly colored, characteristic tints — red, brownish-purple, and green — are often given to extensive areas of snow and ice by the myriads of these minute beings which occur together.

Under the title ' Insect-life in arctic lands,' Dr. Christopher Aurivillius gives an account of the expeditions which have enriched our knowledge of arctic insects, of the number of species of each order of insects collected, and of the literature of the subject. He explains that the uniformity of the arctic fauna becomes more striking as the north pole is approached, but that three subdivisions are recognizable: these he terms the Scandinavian arctic, the Asiatic arctic, and the American arctic regions. A brief notice of the influence of the retreating glacial sheet, in the past, in leaving colonies of arctic insects on mountains, — of which Mount Washington, N.H., is especially mentioned, — is followed by a discussion of the difference in relative proportion of species of the different orders of insects in arctic and temperate lands, and the causes of this unequal distribution. Insect metamorphoses are stated to take longer time in arctic than in temperate lands; Oeneis Bore requiring two years to complete its changes, passing from five to six weeks as a subterranean pupa. The co-ordinate development of plants and insects in geological time, especially the correspondence in the development of suctorial mouth-parts of insects and of flowers with concealed or not easily accessible honey, is outlined; and the relationship of the distribution of arctic insects to the arctic flora is illustrated by a tabular synopsis of the nature of the flowers, and the distribution of different arctic plants. This synopsis shows that anemophilous flowers diminish in number toward the north, and that the flowers fertilized by flies, bees, and Lepidoptera, bear nearly direct relationship to the dipterous, hymenopterous, and lepidopterous fauna of each region. A few flowers, however, which are fertilized by bees farther south, are self-fertilized in the arctic regions: such are the flowers of the two species of Pedicularis found in Spitzbergen, where careful search has failed to discover humble-bees. The author uses this peculiarity of Pedicularis to show the inapplicability of Darwin's theory that the deterioriation of species by self-fertilization is an explanation of the origin of cross-fertilization by insects. Dr. Aurivillius shows, further, that the colors of arctic flowers tend to confirm what is known of the color-sense of the insects that visit them.

H. Hildebrand devotes nearly one hundred pages to a discussion of our knowledge of the art of the lower races of savage people, especially of the Chukchi, Eskimo, Bushmen, Australians, Melanesians, and the people of the stone age in western and northern Europe. He puts aside considerations based on physical or linguistic features, and discusses merely the aesthetic relations of the different people as evidenced by their more or less artistic productions. From this point of view, the people of Chukchi race, studied by the Vega party, are closely assimilated to the Eskimo; more so, indeed, than the pure race characteristics would justify: for it must not be forgotten that the bone-carvings and pictures of the so-called ' sedentary Chukchi ' are mere copies borrowed from the art of the Eskimo, to whose mode of life the loss of their deer has driven a portion of a different people, whose normal development and culture away from the coast shows little or nothing of such art-work. Their stage of ethnic development is, however, much the same. The peculiarities of the art of people in this stage, whether exhibited by the quaternary specimens from the caves of Perigord, or those of the present day from Bering Strait, are to be ascribed to common features of aesthetic evolution in the mind of man, of which the rude pictures drawn by civilized children offer at once a reminiscence and an example.

In an article which covers ninety-four pages, Nordenskiöld himself considers the geological significance of the cosmical material which falls upon the earth's surface. The nebular hypothesis of Kant and Laplace is briefly outlined, and the arguments in favor of the existence of matter in the form of ether are advanced. The author believes that the

original etheriform mass of our solar system condensed to cosmical clouds; the solid particles aggregated, forming large rotating bodies like the earth, which continue to enlarge by the addition of cosmical material from without. It is claimed that many meteorites are simply aggregations of meteroic dust; and numerous examples of the precipitation of such matter are described. The suggestion that eruptive rocks may be derived from accumulations of this kind is of special interest, since by some authors meteoric and eruptive rocks are classed together.

NOTES AND NEWS.

In speaking of the benefit to be expected from the large telescope now building, Professor Asaph Hall recently said that we must not commit the common error of expecting too much from the use of such instruments. Measured by the relative amount of light gathered, the gain seems great; but, when we pass from a fifteen-inch objective to one of thirty inches in diameter, our gain in the visibility of stars is only one and a half magnitudes. It is true that the number of stars brought to view by the larger glass in the shell of our great celestial sphere is very great; but they are of the faintest kind, and the study of these stars is very laborious. And, moreover, all the obvious and striking discoveries of astronomy have been made long since.

— The fifty-fifth annual meeting of the British association, says *Nature*, will commence on Wednesday, Sept. 9, 1885, at Aberdeen. The president-elect is Sir Lyon Playfair. The vice-presidents are the Duke of Richmond and Gordon, the Earl of Aberdeen, the Earl of Crawford and Balcarres, James Matthews, Professor Sir William Thomson, Alexander Bain, the Very Rev. Principal Pirie, Prof. W. H. Flower; general treasurer, Prof. A. W. Williamson; general secretaries, Capt. Douglas Galton, A. G. Vernon Harcourt; secretary, Prof. T. G. Bonney; local secretaries, J. W. Crombie, Angus Fraser, Prof. G. Pirie; local treasurers, John Findlater, Robert Lumsden. The sectional officers are as follows: — *A. Mathematical and physical science:* president, Prof. G. Chrystal; vice-presidents, Prof. C. Niven, Prof. A. Schuster; secretaries, R. E. Baynes, R. T. Glazebrook, Prof. W. M. Hicks (recorder), Prof. W. Ingram. *B. Chemical science:* president, Prof. H. E. Armstrong; vice-presidents, Prof. A. Crum Brown, Prof. H. McLeod; secretaries, Prof. P. Phillips Bedson (recorder), H. B. Dixon, H. Forster Morley, W. J. Simpson. *C. Geology:* president, Prof. J. W. Judd; vice-presidents, John Evans, Prof. W. C. Williamson; secretaries, C. E. De Rance, J. Horne, J. J. H. Teall, W. Topley (recorder). *D. Biology:* president, Prof. W. C. McIntosh; vice-presidents, Prof. I. Bayley Balfour, Prof. J. S. Burdon Sanderson; secretaries, W. Heape, J. Duncan Matthews, Howard Saunders (recorder), H. Marshall Ward. *E. Geography:* president, Lieut.-Gen. J. T. Walker; vice-presidents, Professor James Donaldson, John Rae; secretaries, J. S. Keltie, J. S. O'Halloran, E. G. Ravenstein (recorder), Rev. G. A. Smith. *F. Economic science and statistics:* president, Professor Henry Sidgwick; vice-presidents, Prof. R. Adamson, Sir Rawson W. Rawson; secretaries, Rev. W. Cunningham, Prof. H. S. Foxwell (recorder), C. McCombie, M.A., J. F. Moss. *G. Mechanical science:* president, Benjamin Baker; vice-presidents, Prof. W. C. Unwin, Prof. H. C. Fleeming Jenkin; secretaries, A. T. Atchison (recorder), F. G. Ogilvie, E. Rigg, H. T. Wood. *H. Anthropology:* president, Francis Galton; vice-presidents, W. Pengelly, Prof. W. Turner; secretaries, G. W. Bloxam (recorder), J. G. Garson, Walter Hurst, A. MacGregor. The first general meeting will be held on Wednesday, Sept. 9, when Lord Rayleigh will resign the chair, and Sir Lyon Playfair, president-elect, will assume the presidency, and deliver an address. On Thursday evening, Sept. 10, there will be a *soirée;* on Friday evening, Sept. 11, a discourse by Prof. W. Grylls Adams; on Monday evening, Sept. 14, a discourse on 'The great ocean-basins,' by John Murray, director of the Challenger expedition commission; on Tuesday evening, Sept. 15, a *soirée*. On Wednesday, Sept. 16, the concluding general meeting will be held. The lecture to workingmen will be on the 'Nature of explosions,' by Mr. H. B. Dixon.

— There has just appeared an index to the first thirty volumes of Pflüger's *Archiv für die gesammte physiologie*, the most important physiological periodical of the world. The contributors include a large majority of the well-known professional physiologists of all countries, and number, altogether, in the neighborhood of six hundred. Most of the names are German, but a remarkable proportion are Russian. Among those whose articles are most numerous, we find W. Engelmann, Heidenhain, Hermann, Luchsinger, Pflüger, Valentin, and Worm-Müller. Although the *Archiv* has been edited with little supervision as to the real merit of the papers, and contains therefore an undue proportion of inferior essays, it still remains the most important single repository of modern physiological research; and the index will be of constant value in rendering the stores it contains more accessible. We commit, we hope, no breach of confidence in stating that the index is due to the well-applied skill and patience of an able American physiologist, who was long associated with Professor Pflüger at Bonn.

— A botanical congress will be held during the Antwerp exhibition, dealing principally with the plant kingdom of the Kongo district. With this view, a Belgian *savant* has drawn up a list of questions, and sent them to be answered at the various cultivation stations of the International society.

— The University of Nebraska is to have a new chemical laboratory, which will furnish accommodations for eighty students in the general laboratory, and for thirty-two in the laboratory for qualitative analysis, besides lecture-rooms and minor laboratories for quantitative work, gas analysis, and assaying.

SCIENCE.

FRIDAY, MAY 29, 1885.

THE MONTEREY PINE AND CYPRESS.

BOTANISTS and tree-lovers have a special interest in Cupressus macrocarpa and Pinus insignis, on account of their very restricted native habitat, and for their value as ornamental trees. The first, the Monterey cypress, is known in the wild state only on the oceanic edge of that notable coniferous grove which extends for a few miles between the Bay of Monterey and the narrow inlet of Carmel; excepting, however, a few trees similarly situated, it is said, near Pescadero, farther north. The large cypress-trees of the Monterey grove, most picturesque in character and in position, are only a dozen or two in number. They are confined to the rocky and wind-beaten headland of the immediate shore. In view of their precarious position, it was gratifying to find, at certain points, that a goodly number of thrifty young trees were successfully competing with the pines for a short distance inland. Yet, hemmed in between the slowly encroaching ocean on one hand, and the forest of pines on the other, the future of this unique habitat is certainly precarious. Its companion, Pinus insignis, seems capable of holding its ground if left to nature. Besides this grove, in which it predominates, the tree naturally occurs here and there for some distance, perhaps on all the hills around Monterey Bay. The oldest and finest specimens I have seen of it are on the eastern side of the little town, accompanied by equally noble live-oaks (Quercus agrifolia), and forming that natural park — now adorned by the landscape-gardener's best art, and kept quite in the finish of an English nobleman's ancestral home — in which stands the noted Hotel del Monte.

It is no part of my object to commend the South Pacific railroad company for the establishment of this attractive resort. Its projectors will doubtless have their reward; but, considering the lavish outlay, one would think that a pecuniary return will be a long time in coming. But I do wish to commend them for an incidental service to botany and dendrology in rendering this habitat of the Monterey pine and cypress reasonably secure. With large and liberal foresight, this company bought the whole grove of Point Pinos and vicinity, supplied it with water from Carmel River, and also with about eighteen miles of drives, around the picturesque bluffs, among the hoary cypresses, and through the beautiful forest in various directions, making of the whole a park appertaining to the hotel, and watchfully caring for its preservation. The grove, fortunately, all belonged to one man, who inherited it: so that its acquisition was practicable, as it certainly was timely; for the trees would probably have been very soon cut away for lumber and firewood, and the ground cut up into building-lots.

Lamentable as the destruction of this grove would have been, yet these two trees would not be lost to California. They are extensively planted everywhere near the coast, especially in the southern part of the state, where they thrive wonderfully and grow rapidly, in situations that no other coniferous trees could well abide. At Monterey and at San Francisco the Monterey pine is most successfully used, in the manner of Pinus maritima in France, for the conversion of sand-dunes into forest. At Monterey many hundreds of trees, taken from the nursery at a foot or two in height, were growing healthfully when planted upon a sea-beach of drifting sand, hardly beyond the reach of winter's spray. At San Francisco this tree has played a conspicuous part in the conversion of a broad tract of shifting sand, which used to flow over into the town, into a beautiful park, already well furnished with trees and shrubs in great variety, as well as with grassy slopes and lawns, — the just pride of the city. Step by step this verdure and

welcome shelter is extending over the remaining sand-hills toward the ocean. The pine is preceded, first by the sand reed-grass (Ammophila), then by the wild lupines, especially by the two shrubby species of the place, — the yellow-flowered Lupinus arboreus, and the silvery-leaved and blue-flowered L. Chamissonis, — which in spring-time are as ornamental as they are useful.

These grounds were most wisely as well as beautifully laid out, the favorable natural configuration of the ground preserved and accentuated, the ample driveways led along easy curves around tree-plantations so placed as to afford very needful shelter from the sea-wind which gives an inclement character to a San Francisco summer. I was sorry to see, that, under a new administration of this park, these good points were not appreciated as they had been, perhaps because they are not apprehended. For changes by no means the better were in progress: the avenues were being widened and straightened to a certain extent, and shelter cut away, seemingly with the object of letting in the harsh west wind, or of facilitating fast driving. Neither of these results could be really desirable.

Although these two handsome trees, the Monterey pine and the Monterey cypress, are wholly unadaptable to the Atlantic United States, as may be said of almost every Californian conifer, it is pleasant to know that they grow fairly well in the warmer parts of England, where they are highly prized. Still the main hope of their perpetuity has respect to their native soil.

There is still another coniferous tree on the Californian coast of equally limited range and precarious destiny; namely, Pinus Torreyana of Parry. According to Dr. Parry (*West-American scientist*, i. 37), this tree "is confined to a coast-line of not more than four miles, and extending scarcely a mile inland," just below San Diego. Dr. Parry makes the timely suggestion that this precious bit of ground should be preserved by the town of San Diego, within the corporate limits of which it lies.

A. Gray.

LETTERS TO THE EDITOR.

A novel snow-slide.

On April 22 and 23 occurred the heaviest snow-fall known at this place. There was but little wind. The temperature was so mild that the flakes were slightly moist as they fell, and hence adhered firmly together. The snow was quite porous at first, but rapidly settled, and became somewhat compact. On tinned roofs and on steep shingled roofs, snow-slides of the common sort were frequent; but, on shingled roofs of moderate slope, I noticed that the snow was slowly moving downwards somewhat like a glacier. The thickness of the snow after settling was about ten inches; and its rate of motion downward varied from one inch to two feet per hour, according to situation. At the eaves it bent downward like a plastic mass, and hung in broad sheets in the air until breaking by its own weight. I have often seen the same thing, but never on so large a scale. In one case, on the north side of a building, the snow-sheet retained the curve which it took as it passed the edge of the roof. It thus bent inward so as to nearly touch the building four feet below the cornice. Measured along the curve, the suspended portion was about five and a half feet long, which certainly shows considerable tenacity of the snow-sheet, considering that it had fallen within thirty-six hours, and that the temperature was such that there was a constant drip of water from the edge of the snow. It should be noted, that, at the last, the whole mass — both the suspended portion and that on the roof — went down in a body, with no breaks anywhere.

G. H. Stone.

Colorado Springs, April 25.

A parasitic leech.

In the summer of 1877, at Fort Bridger, Wyoming, while partaking of the hospitality of my friend Dr. J. Van A. Carter, a Shoshone Indian brought to the house a fish to be served for the table. It was caught in the neighboring stream, Black's Fork of Green River, and was known in the locality as the 'Hela' (Gila?), or whitefish. I made it out to be the so-called Colorado pike, Ptychochilus lucius. It was upwards of two feet in length. My attention was directed to it by Dr. Carter, who informed me that the fish was liable to be infested with leeches in the mouth. On examining the specimen, I detected a dozen leeches suspended to the sides of the tongue by their terminal sucker. On disturbance, they became very lively, clinging tightly to their position, alternately elongating and shortening, and projecting and retracting, the head extremity in the usual manner of their allies. They appeared of a translucent blackish hue, with eight longitudinal, equidistant, raw-sienna colored stripes. In the contracted state they were from an inch to an inch and a quarter long by less than half an inch broad, elliptical, and with the head extremity rather abruptly narrowed and more or less prolonged. Elongated, they were up to two and a half inches by about one-third of an inch at the broadest part, and, as represented in the accompanying figure, which is of the natural size, were variably cylindro-clavate, thickest behind, and tapering forward, and more or less constricted at different points. The caudal sucker, by which the leech tightly adhered to its position, was of the usual circular form and proportions. After removing the tongue of the fish, and laying it in a dish of water, in the course of an hour the leeches voluntarily detached themselves, and moved about, or clung to the bottom of the dish. The integument is smooth,

thin, and transparent, so that the chief organs within were visible through it. There were no eye-spots. The mouth, when expanded, appeared as an ovoid sucker, with the orifice somewhat diamond-shaped; and it was neither armed with teeth, nor provided with a proboscis. The oesophagus is narrow, and opens into a capacious stomach, which forms ten or eleven horizontal discoid saccules, which were filled with a blackish-brown liquid, apparently blood. The stomach is surrounded by eight tortuous, gland-like organs, which extend the entire length of the body, and give rise to the colored stripes seen through the skin. These organs are composed of numerous pyriform acini, and appear like racemose glands, but their nature I did not determine. The specimens were preserved in alchohol with the view of further investigation, but they have softened to such a degree that the examination has proved unsatisfactory. From the conspicuous gland-like organs and the habit of the leech, I propose to name it Adenobdella oricola.

In the stomach of the same fish there were some little tape-worms, which I suppose to be the Taenia torulosa, originally described from European species of Leuciscus and other species of the same family. The worms were white, filiform, compressed cylindrical, and from three to six inches long. The head is oval, without rostrum or hooks, and with four equidistant, spherical, immersed bothria. The neck is narrowed and moderately long. The body widens to the posterior fourth, and then gradually narrows. The segments are wider than long, and not prominent. The generative apertures are marginal, with the penes projecting; diameter of the head, one-third of a line; greatest breadth of the body, three-fourths of a line.

Joseph Leidy.

Mortality experience of life-insurance companies.

That figures have a great capacity for lying, and that nothing needs closer watching than an argument based on statistics, are facts which ought to be well impressed on everybody's mind. On almost every subject of public importance, — politics, finance, economic policy, social science, — one is continually solicited to believe in this or that doctrine because statistics 'prove' it to be true. And a large part of the error that prevails on many of these subjects — notably, on the question of free trade and protection — is due, on the one hand, to the reckless way in which statistics are handled by writers, and, on the other, to the absence among their readers of a wholesome suspicion of statistical arguments, and of the abiding consciousness that statistics do not always mean what they seem at first sight to say.

Such being the case, it is a pity that Professor Newcomb — than whom surely no one is more free from the mental defects to which these errors are usually due — should have made so many slips in a recent article in *Science* on mortality statistics. One cannot help asking whether Homer's nods come, like misfortunes, many at a time.

A curious logical slip occurs in the passage relating to the influence of occupation upon mortality. "How little mere occupation has to do with viability, is shown by the fact, that, while bankers and capitalists suffer one-fourth less, brokers, speculators, and operators suffer twelve per cent more, than the tabular mortality." In other words, from the fact that in two occupations seemingly very similar the rates of mortality are widely different, the inference is drawn that occupation has little or nothing to do with the matter. Obviously, the true inference is, that either the statistics are inadequate to the making of the comparison in question, or that the occupations which seemed to be similar are really widely different. If we are sure the occupations are practically alike, we must conclude that the statistics are insufficient, or subject to a bias: if we are sure that the statistics are sufficient and impartial, we must conclude that some important difference is to be found in the occupations; and, in point of fact, there is a very striking difference between the calling of an operator in stocks and that of a legitimate banker or sound capitalist.

In the same paragraph we are told that travelling-agents have the greatest viability of all. This is somewhat surprising; but the fact is deprived of all significance when one finds, on turning to the tables, that the total number of deaths in this class was only eight. So with regard to the excessive mortality of the younger class. The whole number of deaths between the ages of seven and twenty is forty-seven, as Professor Newcomb mentions, while the American table would make it thirty-three. An aggregate excess of fourteen deaths is too slender a basis to rest any inference upon, and is not so surprising as to render an explanation absolutely necessary. It happens, however, that it is in a great measure explained by the fact that (as pointed out in the text accompanying the tables) almost the entire excess occurs among the lives insured under term-policies; i.e., policies issued to extend over a particular period only, and taken for the purpose of covering special risks.

As to the most important point discussed by Professor Newcomb, — whether Herbert Spencer, and those who share his 'superstition,' are right in believing that the most active and enterprising Americans injure their health, and shorten their lives, by too great devotion to business, — I cannot think that these mortality statistics are any thing like a 'sure test' of the question. The class referred to is mixed up with other classes; and, unless we can compare the mortality in this class with the mortality in the same class in England, our inferences must be very guarded indeed. Moreover, there are many things affecting selection — strictness of examination, privilege of surrender, popularity of life insurance — which may greatly differ in the two countries, and largely influence the result. The great excess of mortality in the case of term-policies, and the considerable deficiency in the case of paid-up policies, shown by the Connecticut mutual tables, are instances of this sort of phenomenon. And, even if we were in possession of a perfectly fair comparison with Englishmen, it would still remain to consider whether Americans would not, in the absence of habits complained of, compare still more favorably with Englishmen. On the question of the effect of overwork, and worry, and ambition to become rich, a little bold *a priori* reasoning is likely to lead to a sounder result than can be derived from statistics not specially designed to test the question. It may be remarked, as throwing some light on the matter, that the actuary of the Connecticut company, after observing that between the ages of fifty-six and seventy-five an undue proportion of the deaths occur among those insured for large amounts, adds, "These results suggest the question whether those who insure for large amounts — often, perhaps generally, men of good incomes,

and living well, but involved in the cares, and burdened with the responsibilities, of great business enterprises — are more liable than other men to break down and die at about these latter ages." The comparison here instituted — between Americans who belong to the classes to which Herbert Spencer's strictures chiefly refer, and other Americans — seems much more likely to lead to a reliable result than a comparison between Americans and Englishmen. F. F.

An attempt to photograph the solar corona.

Judging by the tone of Dr. Huggins's communication in *Science* for May 15, I think he fails to understand a point I particularly emphasized in my communication of April 3; namely, that I was not criticising his work, but merely stating the results of my own investigations. I have not, as yet, had an opportunity to experiment with a reflector; but, when we consider the greater visibility of minute companions of bright stars in refractors as compared with reflectors, it does not seem evident how chromatic aberration and internal reflection from the surfaces of a lens can totally unfit it for work, which, according to Dr. Huggins, is perfectly possible for a reflector. In the mean time, an account of some experiments which I have recently made with my refractor may be of interest.

Dr. Huggins suggests that the dark fringe on the negative, which was obtained around the sun, is largely due to diffraction at the instants of opening and closing my shutter. If this were so, the darkening should extend farthest, and be most marked in the direction parallel to the line of motion of the shutter, and should be almost *nil* in the direction at right angles to this line. A careful inspection of my results shows no such effect, the greatest darkening lying sometimes in one direction, and sometimes in another. I therefore think that this objection, although theoretically sound, is not of practical importance with my apparatus. The real causes which would tend to produce a dark fringe around the sun's image are fourfold, and may be classified as follows: (*a*) the solar corona, (*b*) the atmospheric reflection, (*c*) instrumental defects, (*d*) photographic properties of the plate. In the last class I include chemical reduction of the particles of the silver salt contiguous to reduced particles of metallic silver; also halos produced by insufficient backing, and irregularities in the film itself. At the time of a partial solar eclipse, the effect of the corona alone is removed from around a portion of the sun's limb, the other three causes of the darkening remaining. By photographing the sun when its disk is half hidden behind a high neighboring building, the first two causes alone of the darkening are removed. By pasting a strip of black paper across the middle of the plate in such a position that the sun's image shall fall, half on the paper, and half on the plate, and then, before development, removing the paper, the first three causes alone of the darkening will be removed, leaving the fourth. By these devices the effect of each of these four causes has been sifted out, and the relative importance of each determined.

Dr. Huggins claims that my results are due almost wholly to instrumental defects, and not to atmospheric reflection. In this I think he is mistaken. The dark fringe is in part due to both causes; but, even in the clearest weather, the part due to atmospheric reflection is still prominent. Dr. Huggins says, "When the sky is free from clouds, but white from a strong scattering of the sun's light, the sun is well defined upon a *sensibly uniform*[1] surrounding of air-glare, but without any indication of the corona. It is only when the sky becomes clear and blue in color that coronal appearances present themselves with more or less distinctness." I do not know what to make of this statement; for it certainly runs counter to all that one would naturally expect, to all visual experience, and to all my photographic results. As every one knows, whether the sky is clear or hazy, that portion of it in the immediate vicinity of the sun is considerably brighter than those portions more remote. To test the matter photographically, on a hazy day such as he describes, I took a picture of the sun when it was half hidden behind a high building. If, as he claims, the dark fringe was due solely to instrumental defects, it should be equally well marked all round the semicircular image of the sun. If, on the other hand, it were due solely to atmospheric reflection, the part protected by the chimney should be entirely devoid of halo. On development, a very strong halo surrounded the sun's image, going as far round as the brick wall. Here it abruptly ceased, and was replaced by a barely perceptible darkening along the straight side of the image. This increase of brilliancy on approaching the sun's limb was very marked. This appearance can be verified by any one visually with a piece of colored glass. It therefore appears evident that a great part of the corona-like fringe shown in my photographs is due to causes outside of the instrument, and hence cannot be diminished by changes in the latter. On the photographs taken at the time of the eclipse, the fringe was as strongly marked in front of the moon as on the other side of the sun. It therefore appears that the effect of the corona was imperceptible as compared with the effect of the other sources of light, although the atmospheric conditions were exceptionably favorable. On a clear day the atmospheric reflection is less marked than on a hazy one, but is still always present. I hope soon to repeat the experiment with an instrument closely resembling that of Dr. Huggins, although the advantages of his form of apparatus do not seem very evident to me.

[1] The italics are my own.

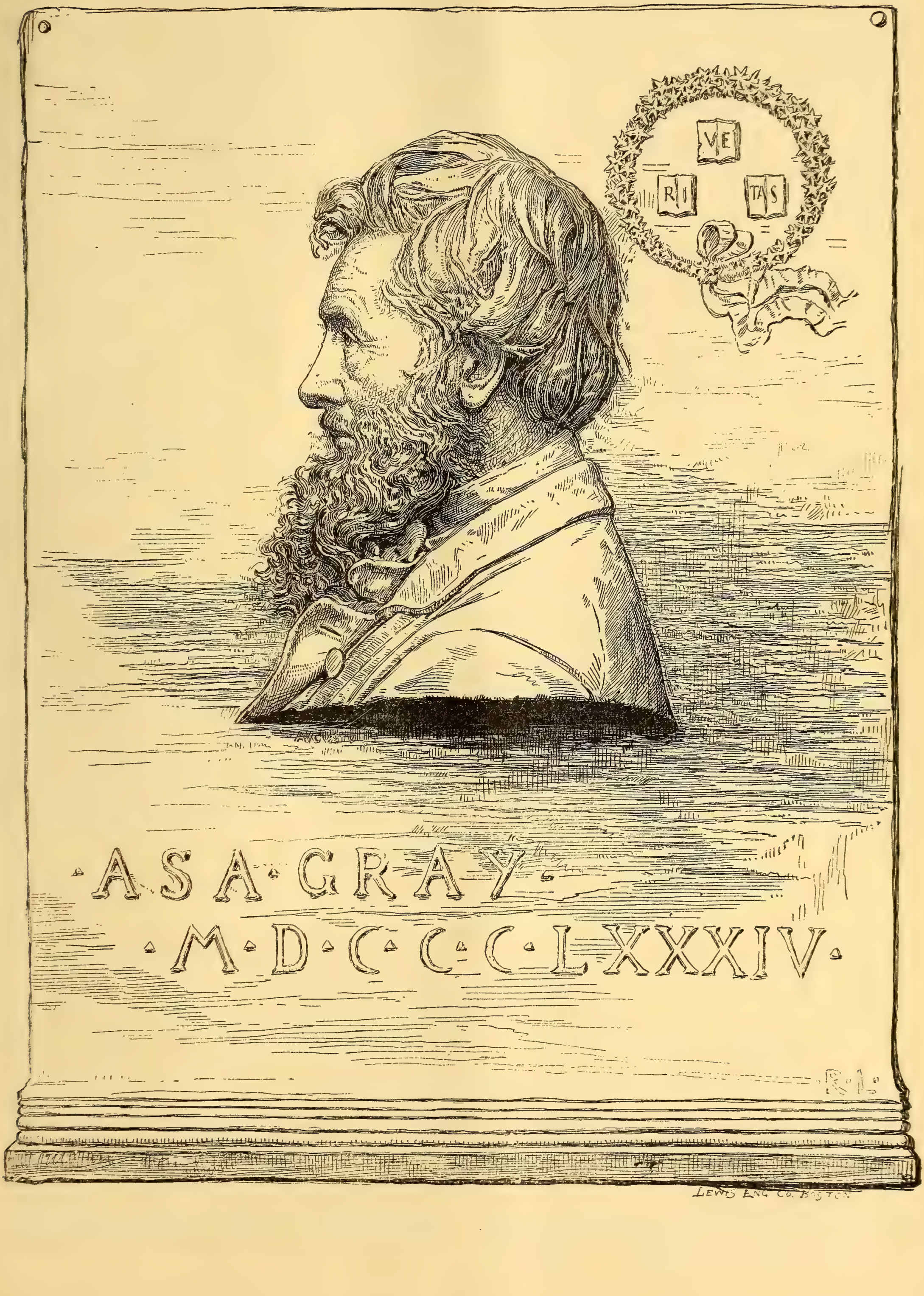
There are one or two points raised in Dr. Huggins's article which should be answered here. As stated in *Science*, April 17, all the plates employed were backed with asphalt varnish. The image of the sun obtained through the violet glass was not reversed, although there is no question but that it would have been, as Dr. Huggins suggests, by a longer exposure. I did not care for a 'different result,' and merely made the statement as one of the facts observed under the conditions named. Dr. Huggins objects to my reference to Dr. Lohse, maintaining that his 'published statement reads differently.' But, in fact, Dr. Lohse only states, that, after overcoming certain difficulties, results were obtained which justify a continuation of the experiments. He does not state that he considers his results coronal, but merely that a continuation of the experiments would be desirable, in which statement I thoroughly agree with him. As I do not feel at liberty to print a private letter, I have written to Dr. Lohse for an exact expression of his views.

Wm. H. Pickering.

Institute of technology, Boston, Mass.

A BRONZE MEDALLION PORTRAIT OF DR. ASA GRAY.

We present to our readers on the opposite page a faithful copy of the admirable bronze medallion, by Saint Gaudens, of Professor Asa


VE
RI
TAS
ASA GRAY
MDCCCLXXXIV
LEWIS ENG. CO. BOSTON

Gray of Harvard university, now on exhibition at the Art museum in Boston. It is an excellent likeness of our distinguished botanist, and a fine specimen of the artist's peculiar work. It has the earnestness and geniality of expression which the passing years seem to impress more forcibly upon Dr. Gray's countenance; and the artist has so wrought the stubborn material as to impart grace and apparent flexibility to the flowing locks. This admirable work of art, representing, as it does in such a thoroughly artistic manner, one of the leading scientific men of America, will be worthily placed upon the walls of the college halls, with which his name and fame will be forever associated. It is a gift to the college from some of the friends and associates of the professor, who have adopted this method of expressing their regard and admiration for his character and scientific achievements.

THE HONG SAL MUN, OR THE RED ARROW GATE.

ONE of the most striking characteristics of far eastern architecture is the singular respect paid to approaches. The means, it may be said, is itself the end. It is not so much what you are to reach, as how you are to reach it, that the Korean deems important. The practice is one branch of the all-pervading ceremonial. To his mind the dignity of an object is best preserved by rendering the access to it imposing. What we see in a nest of Chinese boxes, one within the other, is an illustration of exactly the same principle: the object always eventually found contained in the innermost is enhanced in value just in proportion to the difficulty of getting at it.

The approaches vary in kind according to the degree of intimacy they bear to the main building. First and outermost stands what is called in Korean the Hong Sal Mun, or 'red arrow gate.' This is a singularly odd and strikingly unique structure, and to the student it derives still further interest from being purely tartar. In origin it is religious, or, more exactly, superstitious: for it dates back to the earliest spirit-worship, — the old mythological days, when a hero was a demigod and a king by ancestry divine; and so, because of his genealogy, it was erected as an outer portal to his gates. For in the aboriginal faith, unchanged to this day, the king is the lineal descendant of the gods, and their representative and mediator to men. Nor did the custom stop there. His glory was reflected upon those who carried out his will, — the official class. From his mansion it was copied for theirs; so that now the distinctive mark of a magistracy is the red arrow gate. This is what it is in Korea. But it is all the more interesting that its acquaintance was not made there. In fact, till now, its presence there was not known. It was in Japan that this curious structure first came to the notice of the western world, and then in connection with temples. It is known there by the name of *torii*, commonly but questionably translated as 'bird's rest.' Originally the portal to Shintō shrines, it was borrowed by Buddhism, and now guards indifferently the approach to buildings of either religion. In this it differs entirely from the use to which it is put in Korea, for there it never does service to Buddhist temples. At first sight, the reason is perhaps not evident; yet its use in the one land explains collaterally its use in the other, and points to a primitive idea, of which both are natural though different applications. In Japan, the mikado is a son of heaven, and head of the Shintō faith, which is the aboriginal belief; church and state are one, Buddhism being but a later addition to the religious wealth of the country; and, by a mistaken analogy only, Buddhism came to make use of this gate, to which, in truth, it was perfectly alien. In Korea, on the other hand, the state is all in all. Instead of the state merging into the church, the church was swallowed up, at least in its outward expressions, by the state. Then, when Buddhism came to be ingrafted on the country, there was no excuse, such as existed in Japan, to give it what had then ceased to be looked upon as peculiarly religious: so it continued to be employed, as before, entirely as a sign of kingly authority, and was never converted into another symbol of Buddhistic show.

Its form differs slightly from that of its Japanese counterpart. It wants the graceful curves that make that so beautiful a structure by itself. It lacks also the other's diversity of material. It is built invariably of wood, and its claim to attention arises rather from a certain quaint grotesqueness than from any intrinsic beauty. Two tall posts, slightly inclined to one another, are crossed by a third, and bound together a short distance above the crossing by still a fourth. All four are perfectly straight. Starting from the lower, and projecting beyond the upper horizontal piece, is a row of vertical beams of wood, spear-shaped. These are the arrows of the name. In the centre is a design as singular to the eye as it is peculiar for its mystic meaning; two

spirals, coiled together, filling the area of a circle. They are emblematic of the positive and negative essences of Chinese philosophy. Above them is the representation of tongues of flame. All this typifies the power of the king, joined, since the nation espoused the morality of Confucius, with a reverence for the sage. As the name implies, the whole is painted a bright red, which, in Korea, is the kingly color. Its height is from thirty to forty feet.

Its situation is striking. It rises by itself in solitary grandeur. It is not connected with either walls or buildings. It stands alone and apart. Nor has it any particular position assigned it. It may stand near to, or far from, the shrine or the magistracy to which it leads. Placed only at a respectful distance, it fulfils but the one condition, — that it shall face what it foretells. It is there to direct the thought as much as to impress the mind. In Japan, where certain mountains are sacred, and worshipped as shrines, it is often met with tens of miles away from what it heralds; alone in the midst of nature, on the top of some high mountain pass, over which lies the road, and from whose summit the pilgrim catches the first view of the desired goal, framed in like a picture between its posts. In Korea it commonly spans the street; so that, in so far at least, passers-by do the king homage. But this is simply because the street is the natural approach. In the rural districts, where the street is wider, the portal's span of twenty feet can only occupy the centre, while the thoroughfare is as much around as under it. And yet so compelling is ceremonial that no one would think of entering save beneath its arch; and in Japan it is counted little short of sacrilege by properly superstitious persons, on their way to the temple or the shrine, to avoid it by going around.

THE RED ARROW GATE IN KOREA.

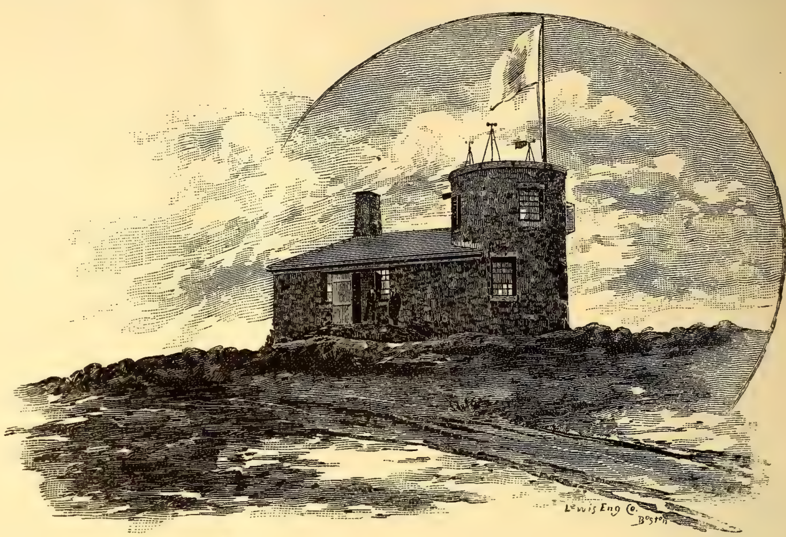
Its discovery in Korea is further interesting as supplying another presumption, amounting almost to proof, in favor of the opinion expressed by Mr. Chamberlain of Tokio, that the ordinarily received meaning of the Japanese name for it, *torii* ('bird's rest'), is erroneous. This is the meaning of the Chinese characters by which it is at present expressed. But though these are the only direct and positive evidence in the matter, they are nevertheless but *prima facie* proof. The Japanese language existed before ever the Chinese ideographs were adopted to write it, and therefore the ideographs with which any word is now written are only evidence of what was considered to be the meaning of that word at the time they were adopted. There is always be-

hind this the Japanese derivation of the word, which, though possible, of course, in the way the characters express it, may be possible also in another way, and that other may really be the true one. Following this course, Mr. Chamberlain suggests that *torii* is not derived from *tori* ('a bird') and *i* ('to be or rest'), but from *tōri* ('to pass through') and *i* ('to be'), which would make it 'a place of passing through.'

To account for such an improbable name as 'bird's rest,' it is customary to instance the well-known respect of the Buddhist religion for animals. The gateway is there, so it is said, to afford a roosting-place for the sacred pigeons which frequent many of the Japanese temples. But as we see, again and emphatically, from Korea, there is no original connection between Buddhism and the *torii;* for the red arrow gate has, in the peninsula, nothing whatever to do with Buddhist temples, and its name there is simply explanatory of its structure. This does not prevent birds roosting on it, as one happened to do at the moment the accompanying photograph was taken, for it must be for them an exceedingly convenient place to roost. But its popularity in Korea at least suggests, that, as regards the custom of the Japanese pigeons, the name probably followed the fact, rather than the fact a dedication. PERCIVAL LOWELL.

THE METEOROLOGICAL OBSERVATORY ON BLUE HILL.

THE meteorological observatory lately constructed by Mr. A. Lawrence Rotch on the summit of Blue Hill, near Boston, at an elevation of six hundred and thirty-five feet, is now in working order; and two monthly bulletins have been issued from it, containing summaries of winds and weather for February and March of the current year. The only other observatories in this country, elevated distinctly above the surrounding region, are those maintained by the U. S. signal-service on Mount Washington and at Pike's Peak, both of which are at elevations greatly above that of Blue Hill. At the level of Pike's Peak, the cyclonic rotation of the winds is hardly observable, the observatory there being above the strata of the atmosphere whose circulation is seriously disturbed by passing storms. On Mount Washington the winds whirl around almost in a circle about the progressing storm-



centre. At Blue Hill we may hope to discover the true circulation of the lower air, unaffected by the natural or artificial irregularities of surface that modify the records of so many of our signal-service stations. The value of observations taken at moderate elevations is attested by the increasing number of mountain observatories in Europe. Ben Nevis is the latest on the list, and its records have already afforded material for several articles in *Nature* and other foreign journals. Germany has a station on the Brocken; France, on the Puy de Dôme and the Pic du Midi; while Switzerland possesses several more. As Blue Hill has the first private observatory of the kind in this country, we shall look with especial interest for the results of studies based upon its records. The accompanying figure is from a photograph taken by the observer, Mr. W. P. Gerrish. The large 'cold-wave' flag, when displayed from the pole on the tower, according to the signal-service predictions, can be seen by a number of villages around the base of the hill. An account of the building was read at a recent meeting of the New-England meteorological society, and published in the December number of the *American meteorological journal.* W. M. D.

AQUATIC PLANTS OF SAN DIEGO.

DURING the wet spring of 1884 I had an excellent opportunity to note the aquatic flora of this vicinity. Doubtless it seldom reaches such luxuriance; and in some years, owing to the scarcity of water, many of the plants certainly make no appearance.

Surface-water reached an exceedingly low stage in 1883; and San Diego was supposed remarkably free from any water-plants, except the wide-spread Azolla, and a few other well-known species. However, the heavy rains of 1884, flooding the entire country, revealed a surprisingly large variety; and that, too, where one would least expect it, — on the broad, usually dry and barren mesas.

The surface-geology of large portions of these mesas is characterized by innumerable hillocks, or small mound-like formations, rising from one to four feet above the intervening depressions, and ranging from ten to fifty feet in diameter. They are generally nearly circular, though often irregular; and the depressions contain in stony places accumulations of cobblestones.

These innumerable hollows naturally become miniature lagoons as soon as heavy rains commence; and soon the leaves of Callitriche are floating upon their surface, while the deeper portions of the little lakes are lined upon the bottom with large patches of Pilularia Americana, Tillaea angustifolia (Nutt.), and Elatine; and along the borders are other minute plants which altogether form a tangled mat of miniature luxuriance, exceeding in comparison the vegetation of the largest lakes. Some of the larger pools, longer covered with water, are filled along the edges with junci, sedges and grasses, among which, at the bottom, Isoetes thrives as well as in the northern lakes.

Later in the season, Downingia pulchella and Pogogyne nudiuscula, with several less conspicuous species, border the pools; and still later a new golden Bloomeria, blue Brodiaeas, and other beautiful Liliaceae, are found; and these, in turn, give way to a few Compositae, preceding the next dry season.

This year another plant, Marsilia vestita, common to lagoons at high altitudes, and also Ammannia latifolia (L.) and Echinodius rostratus (Engelm.), grew abundantly in this vicinity, on the borders of a usually dry flat, near the level of the sea. Other aquatics were found in great quantity throughout the country; and nearly two dozen species of common water-plants, previously unknown to this section, were added to the local flora. C. R. ORCUTT.

SUNLIGHT AND THE EARTH'S ATMOSPHERE.[1]

THERE is, we may remember, a passage in which Plato inquires what would be the thoughts of a man who, having lived from infancy under the roof of a cavern, where the light outside was inferred only by its shadows, was brought for the first time into the full splendors of the sun. We may have enjoyed the metaphor without thinking that it has any physical application to ourselves, who appear to have no roof over our heads, and to see the sun's face daily; while the fact is, that if we do not see that we have a roof over our heads in our atmosphere, and do not think of it as one, it is because it seems so transparent and colorless.

Now, I wish to ask your attention to-night to considerations in some degree novel, which appear to me to show that it is not transparent, as it appears, and that this seeming colorlessness is a sort of delusion of our senses, owing to which we have never in all our lives seen the true color of the sun, which is in reality blue rather than white, as it looks; so that this air all about and above us is acting like a colored glass roof over our heads, or a sort of optical sieve, holding back the excess of blue in the original sunlight, and letting only the white sift down to us. I will first ask you, then, to consider that this seeming colorlessness of the air may be a delusion of our senses, due to habit, which has never given us any thing else to compare it with.

If that cave had been lit by sunshine coming through a reddish glass in its roof, would the perpetual dweller in it ever have had an idea but that the sun was red? How is he to know that the glass is 'colored,' if he has never in his life any thing to compare it with? How can he have any idea but that this is the sum of all the sun's radiations (corresponding to our idea of white or colorless light)? Will not the habit of his life confirm him in the idea that the sun is red? and will he not think that there is no color in the glass, so long as he cannot go outside to see? Has this any suggestion for us, who have none of us ever been outside our crystal roof to see? We must all acknowledge in the abstract, that habit is equally strong in us, whether we dwell in a cave or under the sky; that what we have thought from infancy will probably appear the sole possible explanation; and that, if we want to break its chain, we should put ourselves, at least in imagination, under conditions where it no longer binds us.

The Challenger has dredged from the bottom of the ocean fishes which live habitually at great depths, and whose enormous eyes tell of the correspondingly faint light which must have descended to them through the seemingly transparent water. It will not be so futile a speculation as it may at first seem, to put ourselves in imagination in the condition of creatures under the sea, and ask what the sun may appear to be to them; for, if the fish who had never

[1] A lecture delivered at the Royal institution, April 17, 1885, by Prof. S. P. LANGLEY of Alleghany. From advance sheets of *Nature*, kindly furnished by the editor.

risen above the ocean-floor were an intelligent being, might *he* not plausibly reason that the dim greenish light of his heaven — which is all he has ever known — was the full splendor of the sun, shining through a medium which all his experience shows is transparent? We ourselves are, in very fact, living at the floor of a great aerial sea, whose billows roll hundreds of miles above our heads. Is it not, at any rate, conceivable that we may have been led into a like fallacy from judging only by what we see at the bottom? May we not, that is, have been led into the fallacy of assuming that the intervening medium above us is colorless because the light which comes through it is so?

I freely admit that all men, educated or ignorant, appear to have the evidence of their senses that the air is colorless, and that pure sunlight is white; so that, if I venture to ask you to listen to considerations which have lately been brought forward to show that it is the sun which is blue, and the air really acts like an orange veil, or like a sieve which picks out the blue and leaves the white, I do so in the confidence that I may appeal to you on other grounds than those I could submit to the primitive man, who has his senses alone to trust to; for the educated intelligence possesses those senses equally, and, in addition, the ability to interpret them by the light of reason; and before this audience it is to that interpretation that I address myself.

Permit me a material illustration. You see through this glass, which may typify the intervening medium of air or water, a circle of white light, which may represent the enfeebled disk of the sun when so viewed. Is this intervening glass colored, or not? It seems nearly colorless; but have we any right to conclude that it is so because it seems so? Are we not *taking it for granted* that the original light which we see through it is white, and that the glass is colorless because the light seems unaltered? and is not an appeal to be made here from sense to reason, which, in the educated observer, recalls that white light is made of various colors, and that whether the original light is really white and the glass transparent, or the glass really colored and so *making* the white, is to be decided only by experiment, by taking away the possibly deceptive medium? I can take away this glass, which was not colorless, but of a deep orange, and you see that the original light was not white, but intensely blue. If we could take the atmosphere away between us and the sun, how can we say that the same result might not follow? To make the meaning of our illustration clearer, observe that this blueness is not a pure spectral blue. It has in it red, yellow, blue, and all the colors which make up white, but blue in superabundance; so that, though the white is, so to say, latent there, the dominant effect is blue. The glass colored veil does not put any thing *in*, but acts, I repeat, like a sieve straining *out* the blue, and letting through to us the white light which was there in the bluishness; and so may not our air do so too?

I think we already begin to see that it is, at any rate, conceivable that we *may* have been hitherto under a delusion about the true color of the sun, though of course this is not proving that we have been so. And it will at any rate, I hope, be evident that here is a question raised which ought to be settled: for the blueness of the sun, if proven, evidently affects our present knowledge in many ways, and will modify our present views in optics, in meteorology, and in numerous other things, — in optics, because we should find that white light is *not* the sum of the sun's radiations, but only of those dregs of them which have filtered down to us; in meteorology, because it is suggested that the temperature of the globe, and the condition of man on it, depend in part on a curious selective action of our air, which picks out parts of the solar heat (for instance, that connected with its blue light), and holds them back, letting other selected portions come to us, and so altering the conditions on which this heat by which we live depends; in other ways innumerable, because, as we know, the sun's heat and light are facts of such central importance, that they affect almost every part of scientific knowledge.

It may be asked, What suggested the idea that the sun may be blue rather than any other color? My own attention was first directed this way many years ago, when measuring the heat and light from different parts of the sun's disk. It is known that the sun has an atmosphere of its own, which tempers its heat, and by cutting off certain radiations, and not others, produces the spectral lines we are all familiar with. These lines we customarily study in connection with the absorbing vapors of sodium, iron, and so forth, which produce them; but my own attention was particularly given to the regions of absorption, or to the color it caused; and I found that the sun's body must be deeply bluish, and that it would shed blue light, except for this apparently colorless solar atmosphere which really plays the part of a reddish veil, letting a little of the blue appear on the centre of the sun's disk where it is thinnest, and staining the edge red, so that to delicate tests the centre of the sun is a pale aqua-marine, and its edge a garnet. The effect I found to be so important, that, if this all but invisible solar atmosphere were diminished by but a third part, the temperature of the British Islands would rise above that of the torrid zone; and this directed my attention to the great practical importance of studying the action of our own terrestrial atmosphere on the sun, and the antecedent probability that our own air was also and independently making the really blue sun into an apparently white one. We actually know, then, beyond conjecture, by a comparison of the sun's atmosphere where it is thickest, and where it is thinnest, that an apparently colorless atmosphere *can* have such an effect; and analogous observations which I have carried on for many years, but do not now detail, show that the atmosphere of our own planet, this seemingly clear air in which we exist like creatures at the bottom of the sea, does do so. We look up through our own air as through something so limpid in its purity, that it appears scarcely matter at all; and we are apt to forget the enormous mass of what seems of such

lightness, but which really presses with nearly a ton to each square foot, so that the weight of all the buildings in this great city, for instance, is less than that of the air above them.

I hope shortly to describe the method of proof that it, too, has been acting like an optical sieve, holding back the blue; but it may naturally be asked, Can our senses have so entirely deceived us that they give no hint of this truth, if it be one? Is the appeal wholly to recondite scientific methods, and are there no indications, at least, which we may gather for ourselves? I think there are, even to our unaided eyes, indications that the seemingly transparent air really acts as an orange medium, and keeps the blue light back in the upper sky.

If I hold this piece of glass before my eyes, it seems colorless and transparent; but it is proved not to be so by looking through it edgewise, when the light, by traversing a greater extent, brings out its true color, which is yellow. Every one knows this in every-day experience. We shall not get the color of the ocean by looking at it in a wineglass, but by gazing through a great depth of it; and so it is with the air. If we look directly up, we look through where it is thinnest; but if we look horizontally through it towards the horizon, through great thicknesses, as at sunrise or sunset, is it not true that this air, where we see its real color most plainly, makes the sun look very plainly yellow or orange? We not only see here, in humid English skies, the 'orange sunset waning slow,' but most of us, in these days of travel, can perfectly testify that the clearest heavens the earth affords, the rosy tint on the snows of Mont Blanc, forerunning the dawn, or the warm glow of the sun as he sets in Egyptian skies, show this most clearly, — show that the atmosphere holds back the blue rays by preference, and lets the orange through.

If next we ask, What has become of the blue that it has stopped? does not that very blue of the mid-day sky relate the rest of the story, — that blue which Professor Tyndall has told us is due to the presence of innumerable fine particles in the air, which act selectively on the solar waves, diffusing the blue light towards us? I hope it will be understood that Professor Tyndall is in no way responsible for my own inferences; but I think it is safe, at least, to say that the sky is not self-luminous, and that, since it can only be shining blue at the expense of the sun, all the light this sky sends us has been taken by our atmosphere away from the direct solar beam, which would grow both brighter and bluer if this were restored to it.

If all that has been said so far renders it possible that the sun may be blue, you will still have a right to say that 'possibilities' and 'maybes' are not evidence, and that no chain of mere hypotheses will draw truth out of her well. We are all of one mind here, and I desire next to call your attention to what I think is evidence.

Remembering that the case of our supposed dweller in the cave who could not get outside, or that of the inhabitants of the ocean-floor who cannot rise to the surface, is really like our own, over whose heads is a crystalline roof which no man from the beginning of time has ever got outside of, — an upper sea to whose surface we have never risen, — we recognize that if we could rise to the surface, leaving the medium whose effect is in dispute wholly beneath us, we should see the sun as it is, and get proof of an incontrovertible kind; and that, if we cannot entirely do this, we shall get nearest to proof under our real circumstances by going as high as we can in a balloon, or by ascending a very high mountain. The balloon will not do, because we have to use heavy apparatus requiring a solid foundation. The proof to which I ask your kind attention, then, is that derived from the actual ascent of a remarkable mountain by an expedition undertaken for that purpose, which carried a whole physical laboratory up to a point where nearly one-half the whole atmosphere lay below us. I wish to describe the difference we found in the sun's energy at the bottom of the mountain, and at the top, and then the means we took to allow for the effect of that part of the earth's atmosphere still over our heads even here, so that we may be said to have virtually got outside it altogether.

Before we begin our ascent, let me explain more clearly what we are going to seek. We need not expect to find that the original sunlight is a pure monochromatic blue by any means, but that though its rays contain red, orange, blue, and all the other spectral colors, the blue, the violet, and the allied tints were originally there in disproportionate amounts; so that, though all which make white were present from the first, the refrangible end of the spectrum had such an excess of color, that the dominant effect was that of a bluish sun. In the same way, when I say briefly that our atmosphere has absorbed this excess of blue and let the white reach us, I mean, more strictly speaking, that this atmosphere has absorbed *all* the colors, but selectively taking out more orange than red, more green than orange, more blue than green; so that its action is wholly a taking-*out*, — an action like that which you now see going on with this sieve, sifting a mixture of blue and white beads, and holding back the blue, while letting the white fall down.

This experiment only rudely typifies the action of the atmosphere, which is discriminating and selective in an amazing degree; and, as there are really an infinite number of shades of color in the spectrum, it would take forever to describe the action in detail. It is merely for brevity, then, that we now unite the more refrangible colors under the general word 'blue,' and the others under the corresponding terms 'orange' or 'red.'

All that I have the honor to lay before you is less an announcement of absolute novelty than an appeal to your already acquired knowledge, and to your reason as superior to the delusions of sense. I have, then, no novel experiment to offer, but to ask you to look at some familiar ones in a new light. We are most of us familiar, for instance, with that devised by Sir Isaac Newton to show that white light is compounded of blue, red, and other colors, where, by

turning a colored wheel rapidly, all blend into a grayish white. Here you see the 'seven colors' on the screen; but, though all are here, I have intentionally arranged them so that there is too much blue, and the combined result is a very bluish white, which may roughly stand for that of the original sun-ray. I now alter the proportion of the colors so as to virtually take out the excess of blue, and the result is colorless or white light. White, then, is not necessarily made by combining the 'seven colors,' or any number of them, unless they are there in just proportion (which is in effect what Newton himself says); and white, then, may be made out of such a bluish light as we have described, not by putting any thing to it, but by taking away the excess which is there already.

Here, again, are two sectors, — one blue, one orange-yellow with the blue in excess, — making a bluish disk where they are revolved. I take out the excess of blue, and now what remains is white. Here is the spectrum itself on the screen, but a spectrum which has been artificially modified so that the blue end is relatively too strong. I recombine the colors (by Professor Rood's ingenious device of an elastic mirror), and they do not make a pure white, but one tinted with blue. I take out the original excess of blue, and what remains combines into a pure white. Please bear in mind that when we 'put in' blue here, we have to do so by straining out other light through some obscuring medium, which makes the spectrum darker, but that, in the case of the actual sunlight, introducing more blue introduces more light, and makes the spectrum brighter.

The spectrum on the screen ought to be made still brighter in the blue than it is, — far, far brighter, — and then it might represent to us the original solar spectrum before it has suffered any absorption either in the sun's atmosphere or our own. The Fraunhofer lines do not appear in it; for these, when found in the solar spectrum, show that certain individual rays have been stopped, or selected for absorption by the intervening atmospheres; and, though even the few yards of atmosphere between the lamp and the screen absorb, it is not enough to show.

Our spectrum, as it appears before absorption, might be compared to an army divided into numerous brigades, each wearing a distinct uniform, — one red, one green, one blue; so that all the colors are represented each by its own body. If, to represent the light absorbed as it progresses, we supposed that the army advances under a fire which thins its numbers, we should have to consider that (to give the case of nature) this destructive fire was directed chiefly against those divisions which were dressed in blue, or allied colors, so that the army was thinned out unequally, many men in blue being killed off for one in red; and that, by the time it has advanced a certain distance under fire, the proportion of the men in each brigade has been altered, the red being comparatively unhurt. Almost all absorption is thus selective in its action, and often in an astonishing degree; killing off, so to speak, certain rays in preference to others, as though by an intelligent choice, and not only destroying most of certain divisions (to continue our illustration), but even picking out certain files in each company. Every ray, then, has its own individuality, and on this I cannot too strongly insist; for just as two men retain their personalities under the same red uniform, and one may fall and the other survive, though they touch shoulders in the ranks, so in the spectrum certain parts will be blotted out by absorption, while others next to them may escape.

To illustrate this selective absorption, I put a piece of didymium glass in the path of the ray. It will, of course, absorb some of the light; but, instead of dimming the whole spectrum, we might almost say it has arbitrarily chosen to select one narrow part for action, in this particular case choosing a narrow file near the orange, and letting all the rest go unharmed. In this arbitrary way our atmosphere operates, but in a far more complex manner, taking out a narrow file here, and another there, in hundreds of places all through the spectrum, but, on the whole, much the most in the blue, the Fraunhofer lines being merely part of the evidence of this wonderful quasi-intelligent action which bears the name of selective absorption.

Before we leave this spectrum, let us recall one most important matter. We know that here, beyond the red, is solar energy in the form of heat, which we cannot see, but not on that account any less important. More than half the whole power of the sun is here invisible, and, if we are to study completely the action of our atmosphere, we shall have to pay great attention to this part, and find out some way of determining the loss in it; which will be difficult, for the ultra-red end is not only invisible, but compressed, the red end being shut up like the closed pages of a book, as you may notice by comparing the narrowness of the red with the width of the blue.

Now, refraction by a prism is not the only way of forming a spectrum. Nature furnishes us color not only from the rainbow, but from non-transparent substances, like mother-of-pearl, where the irridescent hues are due to microscopically fine lines. Art has lately surpassed nature in these wonderful 'gratings,' consisting of pieces of polished metal, in which we see at first nothing to account for the splendid play of color apparently pouring out from them like light from an opal, but which, on examination with a powerful microscope, show lines so narrow that there are from fifty to a hundred in the thickness of a fine human hair, and all spaced with wonderful precision.

This grating is equal in defining-power to many such prisms as we have just been looking at, but its light does not show well upon the screen. You will see, however, that its spectrum differs from that of the prism, in that in this case the red end is expanded, as compared with the violet, and the invisible ultra-red is expanded still more; so that this will be the best means for us to use in exploring that 'dark continent' of invisible heat found in the spectrum not only of the sun, but of the electric light, and of all incandescent bodies, and of whose existence we already know from Herschel and Tyndall.

Now, we cannot reproduce the actual solar spectrum

on the screen, without the sun itself; but here are photographs of it, which show parts of the losses the different colors have suffered on their way to us. We have before us the well-known Fraunhofer lines, due, you remember, not only to absorption in the sun's atmosphere, but also to absorption in our own. We have been used to think of them in connection with their cause, one being due to the absorption of iron-vapor in the sun, another to that of water-vapor in our own air, and so forth; but now I ask you to think of them only in connection with the fact that each is due to the absorption of some part of the original *light*, and that collectively they tell much of the story of what has happened to that light on its way down to us. Observe, for instance, how much thicker they lie in the blue end than in the red, — another evidence of the great proportionate loss in the blue.

If we could restore all the lost light in these lines, we should get back partly to the original condition of things at the very fount; and, so far as our own air is concerned, that is what we are to ascend the mountain for, — to see, by going up through nearly half of the atmosphere, what the rate of loss is in each ray by actual trial; then, knowing this rate, to be able to allow for the loss in the other part still above the mountain-top; and, finally, by recombining these rays, to get the loss as a whole. Remember, however, always, that the most important part of the solar energy is in the dark spectrum, which we do not see, but which, if we could see, we should probably find to have numerous absorption-spaces in it corresponding to the Fraunhofer lines, but where heat has been stopped out rather than light. To make our research thorough, then, we ought not to trust to the eye only, or even chiefly, but have some way of investigating the whole spectrum, — the invisible, in which the sun's power chiefly lies, as well as the visible, and both with an instrument that would discriminate the energy in these very narrow spaces like an eye to see in the dark; and, if science possesses no such instrument, then it may be necessary to invent one.

The linear thermopile is nearest to it of any, and we all here know what good work it has done; but even that is not sensitive enough to measure in the grating spectrum, in some parts of which the heat is four hundred times weaker than in that of a prism, and we want to observe this invisible heat in very narrow spaces. Something like this has been provided since by Capt. Abney's most valuable researches; but these did not at the time go low enough for my purpose, and I spent nearly a year, before ascending the mountain, in inventing and perfecting the new instrument for measuring these, which I have called the 'bolometer,' or 'ray-measurer.' The principle on which it is founded is the same as that employed by my late lamented friend, Sir William Siemens, for measuring temperatures at the bottom of the sea, which is, that a smaller electric current flows through a warm wire than through a cold one.

One great difficulty was to make the conducting-wire very thin, and yet continuous; and for this purpose, almost endless experiments were made; among other substances, pure gold having been obtained by chemical means in a plate so thin that it transmitted a sea-green light through the solid substance of the metal. This proving unsuitable, I learned that iron had been rolled of extraordinary thinness in a contest of skill between some English and American iron-masters; and, procuring some, I found that fifteen thousand of the iron plates they had rolled, laid one on the other, would make but one English inch. Here is some of it, rolled between the same rolls which turn out plates for an iron-clad, but so thin, that, as I let it drop, the iron plate flutters down like a dead leaf. Out of this the first bolometers were made; and I may mention that the cost of these earlier experiments was met from a legacy by the founder of the Royal institution, Count Rumford. The iron is now replaced by platinum, in wires, or rather tapes, from a two-thousandth to a twenty-thousandth of an inch thick, one of which is within this button, where it is all but invisible, being far finer than a human hair. I will project it on the screen, placing a common small pin beside it as a standard of comparison. This button is placed in this ebonite case, and the thread is moved by this micrometer screw, by which it can be set like the spider-line of a reticule; but by means of this cable, connecting it to the galvanometer, this thread acts as though sensitive, like a nerve laid bare to every indication of heat and cold. It is, then, a sort of sentient thing: what the eye sees as light it feels as heat, and what the eye sees as a narrow band of darkness (the Fraunhofer line) this feels as a narrow belt of cold; so that, when moved parallel to itself and the Fraunhofer lines down the spectrum, it registers their presence.

It is true, we can see these in the visible spectrum. But you remember, we propose to explore the invisible also; and, since to this the dark is the same as the light, it will feel absorption-lines in the infra-red which might remain otherwise unknown.

I have spent a long time in these preliminary researches, in indirect methods for determining the absorption of our atmosphere, and in experiments and calculations which I do not detail; but it is so often supposed that scientific investigation is a sort of happy guessing, and so little is realized of the labor of preparation and proof, that I have been somewhat particular in describing the essential parts of the apparatus finally employed; and now we must pass to the scene of their use.

We have been compared to creatures living at the bottom of the sea, who frame their deceptive traditional notions of what the sun is like from the feeble, changed rays which sift down to them. Though such creatures could not rise to the surface, they might swim up towards it; and if these rays grew hotter, brighter, and bluer, as they ascended, it would be almost within the capacity of a fish's mind to guess that they are still brighter and bluer at the top. Since we children of the earth, while dwelling on it, are always at the bottom of a sea, though of another sort, the most direct method of proof I spoke of, is merely

to group as far as we can, and observe what happens; though, as we are men, and not fishes, something more may fairly be expected of our intelligence than of theirs.

We will not only guess, but measure and reason; and in particular we will first, while still at the bottom of the mountain, draw the light and heat out into a spectrum, and analyze every part of it by some method that will enable us to explore the invisible, as well as record the visible. Then we will ascend many miles into the air, meeting the rays on the way down, before the sifting process has done its whole work, and there analyze the light all over again, so as to be able to learn the different proportions in which the different rays have been absorbed, and, by studying the action on each separate ray, to prove the state of things which must have existed before this sifting — this selective absorption — began.

It may seem at first that we cannot ascend far enough to do much good, since the surface of our aerial ocean is hundreds of miles overhead; but we must remember that the air grows thinner as we ascend, the lower atmosphere being so much denser that about one-half the whole substance or mass of it lies within the first four miles, which is a less height than the tops of some mountains. Every high mountain, however, will not do: for ours must not only be very high, but very steep; so that the station we choose at the bottom may be almost under the station we are afterwards to occupy at the top. Besides, we are not going to climb a lofty, lonely summit, like tourists, to spend an hour, but to spend weeks; so that we must have fire and shelter, and, above all, we must have dry air to get clear skies. First I thought of the Peak of Teneriffe; but afterwards some point in the territories of the United States seemed preferable, particularly as the government offered to give the expedition, through the signal-service, and under the direction of its head, Gen. Hazen, material help in transportation, and a military escort, if needed, anywhere in its own dominions. No summit in the eastern part of the United States rises much over seven thousand feet, and, though the great Rocky Mountains reach double this, their tops are the home of fog and mist; so that the desired conditions, if met at all, could only be found on the other side of the continent, in southern California, where the summits of the Sierra Nevadas rise precipitously out of the dry air of the great wastes in lonely peaks, which look eastward down from a height of nearly fifteen thousand feet upon the desert lands.

This remote region was, at the time I speak of, almost unexplored; and its highest peak, Mount Whitney, had been but once or twice ascended, but was represented to be all we desired, could we once climb it. As there was great doubt whether our apparatus, weighing several thousand pounds, could possibly be taken to the top, and we had to travel three thousand miles even to get where the chief difficulties would begin, and make a desert journey of a hundred and fifty miles after leaving the cars, it may be asked why we committed ourselves to such an immense journey, to face such unknown risks of failure. The answer must be, that mountains of easy ascent, and fifteen thousand feet high, are not to be found at our doors, and that these risks were involved in the nature of our novel experiment; so that we started out from no love of mere adventure, but from necessity, much into the unknown. The liberality of a citizen of Pittsburgh, to whose encouragement the enterprise was due, had furnished the costly and delicate apparatus for the expedition; and that of the transcontinental railroads enabled us to take this precious freight along in a private car, which carried a kitchen, a steward, a cook, and an ample larder besides.

In this we crossed the entire continent from ocean to ocean, stopped at San Francisco for the military escort, went three hundred miles south so as to get below the mountains, and then turned eastward again on to the desert, with the Sierras to the north of us, after a journey which would have been unalloyed pleasure except for the anticipation of what was coming as soon as we left our car. I do not, indeed, know that one feels the triumphs of civilization over the opposing forces of nature anywhere more than in the sharp contrasts which the marvellous luxury of recent railroad accommodation gives to the life of the desert. When one is in the centre of one of the great barren regions of the globe, and, after looking out from the windows of the flying train on its scorched wastes for lonely leagues of habitless desolation, turns to his well-furnished dinner-table, and the fruit and ices of his dessert, he need not envy the heroes of oriental story who were carried across dreadful solitudes in a single night on the backs of flying genii. Ours brought us over three thousand miles to the Mojave desert. It was growing hotter and hotter when the train stopped in the midst of vast sand-wastes a little after midnight. Roused from our sleep, we stepped on to the brown sand, and saw our luxurious car roll away in the distance, experiencing a transition from the conditions of civilization to those almost of barbarism, as sharp as could well be imagined. We commenced our slow toil northward with a thermometer at 110° in the shade, if any shade there be in the shadeless desert, which seemed to be chiefly inhabited by rattlesnakes of an ashen gray color and a peculiarly venomous bite. There is no water save at the rarest intervals; and the soil at a distance seems as though strewed with sheets of salt, which aids the delusive show of the mirage. These are, in fact, the ancient beds of dried-up salt lakes or dead seas, some of them being below the level of the ocean; and such a one on our right, though only about twenty miles wide, has earned the name of 'Death Valley,' from the number of human beings who have perished in it. Formerly an emigrant-train, when emigrants crossed the continent in caravans, had passed through the great Arizona deserts in safety, until, after their half-year's journey, their eyes were gladdened by the snowy peaks of the Sierras looking delusively near. The goal of their long toil seemed before them: only this one more valley lay between; and into this they descended, thinking to cross it in a day, but they never crossed it. Afterwards the long line of wagons was found, with the skeletons of the animals in the

harness, and by them those of men, women, and little children, dead of thirst; and some relics of the tragedy remained at the time of our journey. I cite this as an indirect evidence of the phenomenal dryness of the region, — a dryness which so far served our object, which was, in part, to get rid, as much as possible, of that water-vapor which is so well known to be a powerful absorber of the solar heat.

Every thing has an end; and so had that journey, which finally brought us to the goal of our long travel at the foot of the highest peak of the Sierras, Mount Whitney, which rose above us in tremendous precipices that looked hopelessly insurmountable and wonderfully near. The whole savage mountain region, in its slow rises from the west, and its descent to the desert plains in the east, is more like the chain called the Apennines, in the moon, than any thing I know on the earth. The summits are jagged peaks, like Alpine 'needles,' looking in the thin air so delusively near, that, coming on such a scene unprepared, one would almost say they were large gray stones a few fields off, with an occasional little white patch on the top that might be a handkerchief or a sheet of paper dropped there. But the telescope showed that the seeming stones were of the height of many Snowdons piled on one another, and the white patches occasional snow-fields, looking how invitingly cool from the torrid heat of the desert, where we were encamped by a little rivulet that ran down from some unseen ice-lake in that upper air. Here we pitched our tents, and fell to work (for you remember we must have two stations, a low and a high one, to compare the results); and here we labored three weeks in almost intolerable heat, the instruments having to be constantly swept clear of the red desert dust which the hot wind brought. Close by these tents, a thermometer covered by a single sheet of glass, and surrounded by wool, rose to 237° in the sun; and sometimes in the tent, which was darkened for the study of separate rays, the heat was absolutely beyond human endurance. Finally, our apparatus was taken apart, and packed in small pieces on the backs of mules, who were to carry it by a ten-days' journey through the mountains to the other side of the rocky wall, which, though only ten or twelve miles distant, arose miles above our heads; and, leaving these mule-trains to go with the escort by this longer route, I started with a guide by a nearer way to those white gleams in the upper skies that had daily tantalized us below in the desert with suggestions of delicious, unattainable cold. That desert sun had tanned our faces to a leather-like brown, and the change to the cooler air as we ascended was at first delightful. At an altitude of five thousand feet we came to a wretched band of nearly naked savages, crouched around their camp-fire, and at six thousand found the first scattered trees; and here the feeble suggestion of a path stopped, and we descended a ravine to the bed of a mountain stream, up which we forced our way, cutting through the fallen trees with an axe, fighting for every foot of advance, and finally passing what seemed impassable. It was interesting to speculate as to the fate of our siderostat mirrors and other precious freight, now somewhere on a similar road, but quite useless. We were committed now, and had to make the best of it; and, besides, I had begun to have my attention directed to a more personal subject. This was, that the colder it grew, the more the sun burnt the skin — quite literally burnt, I may say; so that by the end of the third day my face and hands, case-hardened, as I thought, in the desert, began to look as if they had been seared with red-hot irons, here in the cold, where the thermometer had fallen to freezing at night; and still, as we ascended, the paradoxical effect increased. The colder it grew about us, the hotter the sun blazed above. We have all heard, probably, of this curious effect of burning in the midst of cold, and some of us may have experienced it in the Alps, where it may be aided by reflection from the snow, which we did not have about us at any time except in scattered patches; but here, by the end of the fourth day, my face was scarcely recognizable, and it almost seemed as though sunbeams up here were different things, and contained something which the air filters out before they reach us in our customary abodes. Radiation here is increased by the absence of water-vapor, too; and, on the whole, this intimate personal experience fell in almost too well with our anticipations that the air is an even more elaborate trap to catch the sunbeams than had been surmised, and that this effect of selective absorption and radiation was intimately connected with that change of the primal energies and primal color of the sun which we had climbed towards it to study.

On the fourth day, after break-neck ascents and descents, we finally ascended by a ravine down which leaped a cataract, till, at nightfall, we reached our upper camp, which was pitched by a little lake, one of the sources of the waterfall, at a height of about twelve thousand feet, but where we seemed in the bottom of a valley, nearly surrounded as we were by an amphitheatre of rocky walls which rose perpendicularly to the height of Gibraltar from the sea, and cut off all view of the desert below, or even of the peak above us. The air was wonderfully clear; so that the sun set in a yellow rather than an orange sky, which was reflected in the little ice-rimmed lakes, and from occasional snow-fields on the distant waste of lonely mountain summits on the west.

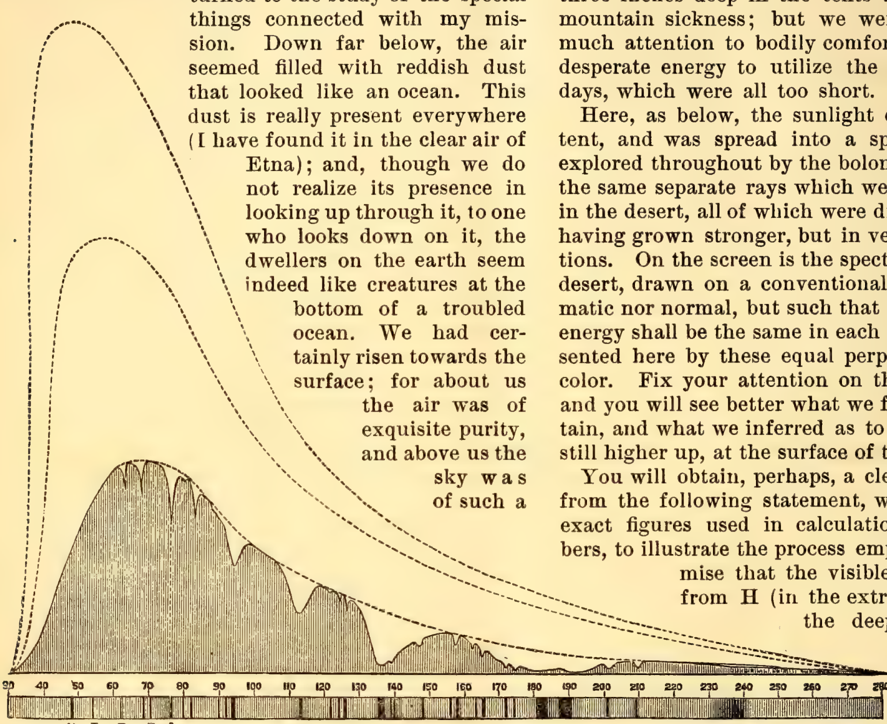
The mule-train, sent off before by another route, had not arrived when we got to the mountain camp, and we realized that we were far from the appliances of civilization by our inability to learn about our chief apparatus; for here, without post or telegraph, we were as completely cut off from all knowledge of what might be going on with it in the next mountain ravine as a ship at sea is of the fate of a vessel that sailed before from the same port. During the enforced idleness, we ascended the peak nearly three thousand feet above us, with our lighter apparatus, leaving the question of the ultimate use of the heavy ones to be settled later. There seemed little prospect of carrying it up, as we climbed where the granite walls had been split by the earthquakes, letting a stream of great rocks, like a stone river, flow down through the interstices by which we ascended; and,

in fact, the heavier apparatus was not carried above the mountain camp.

The view from the very summit was over numberless peaks on the west to an horizon, fifty miles away, of unknown mountain-tops; for, with the exception of the vast ridge of Mount Tyndall, and one or two less conspicuous ones, these summits are not known to fame; and, wonderful as the view may be, all the charm of association with human interest which we find in the mountain landscape of older lands is here lacking. It was impossible not to be impressed with the savage solitude of this desert of the upper air, and our remoteness from man and his works; but I turned to the study of the special things connected with my mission. Down far below, the air seemed filled with reddish dust that looked like an ocean. This dust is really present everywhere (I have found it in the clear air of Etna); and, though we do not realize its presence in looking up through it, to one who looks down on it, the dwellers on the earth seem indeed like creatures at the bottom of a troubled ocean. We had certainly risen towards the surface; for about us the air was of exquisite purity, and above us the sky was of such a deep violet-blue as I have never seen in Egypt or Sicily: and yet even this was not absolutely pure, for, separately invisible, the existence of fine particles could yet be inferred from their action on the light near the sun's edge; so that even here we had not got absolutely above that dust-shell which seems to encircle our whole planet. But we certainly felt ourselves not only in an upper, but a different region. We were on the ridge of the continent; and the winds which tore by had little in common with the air below, and were bearing past us (according to the geologists) dust which had once formed part of the soil of China, and been carried across the Pacific Ocean: for here we were lifted into the great encircling currents of the globe, and, 'near to the sun in lonely lands,' were in the right conditions to study the differences between his rays at the surface, and at the bottom of that turbid sea where we had left the rest of mankind. We descended the peak, and hailed with joy the first arrival of our mule-trains with the requisite apparatus at the mountain camp, and found that it had suffered less than might be expected, considering the pathless character of the wilderness. We went to work to build piers, and mount telescopes and siderostats, in the scene shown by the next illustration on the screen, taken from a sketch of my own, where these rocks in the immediate foreground rise to thrice the height of St. Paul's. We suffered from cold (the ice forming three inches deep in the tents at night) and from mountain sickness; but we were too busy to pay much attention to bodily comfort, and worked with desperate energy to utilize the remaining autumn days, which were all too short.

Here, as below, the sunlight entered a darkened tent, and was spread into a spectrum, which was explored throughout by the bolometer, measuring on the same separate rays which we had studied below in the desert, all of which were different up here, all having grown stronger, but in very different proportions. On the screen is the spectrum as seen in the desert, drawn on a conventional scale, neither prismatic nor normal, but such that the intensity of the energy shall be the same in each part, as it is represented here by these equal perpendiculars in every color. Fix your attention on these three as types, and you will see better what we found on the mountain, and what we inferred as to the state of things still higher up, at the surface of the aerial sea.

You will obtain, perhaps, a clearer idea, however, from the following statement, where I use, not the exact figures used in calculation, but round numbers, to illustrate the process employed. I may premise that the visible spectrum extends from H (in the extreme blue) to A (in the deepest red), or from near 40 (the ray of forty hundred-thousandths of a millimetre in wave-length) to near 80. All below 80, to the right, is the invisible infra-red spectrum. Now, the shaded curve above the spectrum represents the amount of energy in the sun's rays at the foot of the mountain, and was obtained in this way: Fix your attention for a moment on any single part of the spectrum; for instance, that whose wave-length is 60. If the heat in this ray, as represented by the bolometer at the foot of the mountain, was (let us suppose) 2°, on any arbitrary scale we draw a vertical line, two inches or two feet high, over that part of the spectrum. If the heat at another point, such as 40, were but ¼°, a line would be drawn there a quarter of an inch high; and so on, till these vertical lines mark out the shaded parts of the drawing, the gaps and depressions in whose outline correspond to the 'cold bands' already spoken of. Again: if on top



DISTRIBUTION OF SOLAR ENERGY AT SEA-LEVEL AND AT VARIOUS ALTITUDES.

of the mountain we measure all these over once more, we shall find all are hotter; so that we must up there make all our lines higher, but *in very different proportions*. At 60, for instance, the heat (and light) may have grown from 2° to 3°, or increased one-half, while above 40 the heat (and light) may have grown from $\frac{1}{5}$° to 1°, or increased five times. These mountain measurements give another spectrum, the energies in each part of which are defined by the middle dotted line, which we see indicates very much greater energy, whether heat or light, in the blue end than below. Next, the light or heat which would be observed at the surface of the atmosphere is found in this way. If the mountain top rises through one-half the absorbing mass of this terrestrial atmosphere (it does not quite do so, in fact), and by getting rid of that lower half the ray 60 has grown in brightness from 2 to 3, or half as much again, in going up to the top it would gain half as much more, or become $4\frac{1}{2}$; while the ray near 40, which has already increased to five times what it was, would increase five times more, or to 25. Each separate ray increasing thus nearly in some geocentric progression (though the heat, as a whole, does not), you see how we are able, by repeating this process at every point, to build up our outer or highest curve, which represents the light and heat at the surface of the atmosphere. These have grown out of all proportion at the blue end, as you see by the outer dotted curve, and now we have attained by actual measurement that evidence which we sought; and by thus reproducing the spectrum outside the atmosphere, and then recombining the colors by like methods to those you have seen on the screen, we finally get the true color of the sun, which tends, broadly speaking, to blue.

It is so seldom that the physical investigator meets any novel fact quite unawares, or finds any thing except that in the field where he is seeking, that he must count it an unusual experience to come unexpectedly on even the smallest discovery. This experience I had on one of the last days of work on the spectrum on the mountain. I was engaged in exploring that great invisible heat-region still but so partially known, or, rather, I was mapping in that great 'dark continent' of the spectrum, and by the aid of the exquisite sky and the new instrument (the bolometer) found I could carry the survey farther than any had been before. I substituted the prism for the grating, and measured on in that unknown region till I had passed the Ultima Thule of previous travellers, and finally came to what seemed the very end of the invisible heat-spectrum, beyond what had previously been known. This was in itself a return for much trouble, and I was about rising from my task, when it occurred to me to advance the bolometer still farther; and I shall not forget the surprise and emotion with which I found new and yet unrecognized regions below, — a new invisible spectrum beyond the farthest limits of the old one.

I will anticipate here by saying, that, after we got down to lower earth again, the explorations and mapping of this new region was continued. The amount of solar energy included in this new extension of the invisible region is much less than that of the visible spectrum; while its length upon the wave-length scale is equal to all that previously known, visible and invisible, as you will see better by this view, having the same thing on the normal as well as the prismatic scale. If it be asked which of these is correct, the answer is, Both of them. Both, rightly interpreted, mean just the same thing; but in the lower one we can more conveniently compare the ground of the researches of others with these. These great gaps I was at first in doubt about; but more recent researches at Alleghany make it probable that they are caused by absorption in our own atmosphere, and not in that of the sun.

We would gladly have staid longer, in spite of physical discomfort; but the formidable descent and the ensuing desert journey were before us, and certainly the reign of perpetual winter around us grew as hard to bear as the heats of the desert summer had been. On Sept. 10 we sent our instruments and the escort back by the former route, and, ourselves unencumbered, started on the adventurous descent of the eastern precipices by a downward climb, which, if successful, would carry us to the plains in a single day. I at least shall never forget that day, nor the scenery of more than Alpine grandeur which we passed in our descent, after first climbing by frozen lakes in the northern shadow of the great peak, till we crossed the eastern ridges, through a door so narrow that only one could pass it at a time, by clinging with hands and feet as he swung round the shoulder of the rocks — to find that he had passed in a single minute from the view of winter to summer, the prospect of the snowy peaks behind shut out, and instantly exchanged for that below of the glowing valley and the little oasis, where the tents of the lower camp were still pitched, the tents themselves invisible, but the oasis looking like a green scarf dropped on the broad floor of the desert. We climbed still downward by scenery unique in my recollection. This view of the ravine on the screen is little more than a memorandum made by one of the party in a few minutes' halt part way down, as we followed the ice-stream between the tremendous walls of the defile which rose two thousand feet, and between which we still descended, till, toward night, the ice-brook had grown into a mountain torrent, and, looking up the long vista of our day's descent, we saw it terminated by the peak of Whitney, once more lonely in the fading light of the upper sky.

This site, in some respects unequalled for a physical observatory, is likely, I am glad to say, to be utilized; the president of the United States having, on the proper representation of its value to science, ordered the reservation, for such purposes, of an area of a hundred square miles about and inclusive of Mount Whitney.

There is little more to add about the journey back to civilization, where we began to gather the results of our observation, and to reduce them; to smelt, so to speak, the metal from the ore we had brought home, — a slow but necessary process, which has occupied a large part of two years. The results, stated

in the broadest way, mean that the sun is blue, but mean a great deal more than that; this blueness in itself being, perhaps, a curious fact only, but, in what it implies, of practical moment. We deduce in connection with it a new value of the solar heat, so far altering the old estimates, that we now find it capable of melting a shell of ice sixty yards thick annually over the whole earth, or, what may seem more intelligible in its practical bearings, of exerting over one-horse power for each square yard of the normally exposed surface. We have studied the distribution of this heat in a spectrum whose limits on the normal scale our explorations have carried to an extent of rather more than twice what was previously known, and we have found that the total loss by absorption from the atmosphere is nearly double what has been heretofore supposed. We have found it probable that the human race owes its existence and preservation to the heat-storing action of the atmosphere even more than has been believed.

The direct determination of the effect of water-vapor in this did not come within our scope; but that the importance of the blanketing action of our atmospheric constituents has been in no way over-stated, may be inferred when I add that we have found by our experiments, that, if the planet were allowed to radiate freely into space, without any protecting veil, its sunlit surface would probably fall, even in the tropics, below the temperature of freezing mercury.

I will not go on enumerating the results of these investigations; but they all flow from the fact, which they in turn confirm, that this apparently limpid sea above our heads, and about us, is carrying on a wonderfully intricate work on the sunbeam, and on the heat returned from the soil, picking out selected parts in hundreds of places, sorting out incessantly at a task which would keep the sorting demons of Maxwell busy, and, as one result, changing the sunbeam on its way down to us in the way we have seen.

I have alluded to the practical utilities of these researches: but, practical or not, I hope we may feel that such facts as we have been considering about sunlight and the earth's atmosphere may be stones useful in the future edifice of science; and that, if not in our own hands, then in those of others when our day is over, they may find the best justification for the trouble of their search in the fact that they prove of some use to man.

May I add an expression of my personal gratification in the opportunity with which you have honored me of bringing these researches before the Royal institution, and my thanks for the kindness with which you have associated yourselves for an hour, in retrospect at least, with that climb toward the stars which we have made together, to find from light in its fulness what unsuspected agencies are at work to produce for us the light of common day.

NOTES AND NEWS.

THE Committee on meteorology, instituted by the International congress of meteorology, will meet for a third session in Paris in the beginning of the coming September. Up to the present time, the following questions have been proposed for consideration during this session: 1°. Report of the secretary on the labors of the committee since the meeting at Copenhagen; 2°. Report of Messrs. Brito Capello, Hildebrandsson, and Ley, on the observation of the cirrus; 3°. Does it seem opportune to soon convene a third international congress of meteorologists? 4°. Establishment of stations of the first order on the Kongo; 5°. Discussion on the utility of the summaries of the state of the weather as published in the different countries, and the eventual preparation of a plan for more uniformity; 6°. Discussion of the utility of the meteorological telegrams from America proposed by Gen. Hazen, and of an eventual organization for their distribution in Europe; 7°. By what means can the timely receipt of meteorological telegrams be assured? 8°. Should the reduction of barometer readings to gravity under 45° of latitude be generally introduced? 9°. Is it desirable to also count in meteorology the hours of the day from 1 h. to 24 h. according to the resolutions of the international conference in Washington? 10°. Designation for a uniformly covered sky according to the form of the clouds; 11°. Definition of rain and snow days; 12°. Should not the general adoption of a uniform height above the earth for rain-gauges be recommended? 13°. What progress has been made lately in the more exact measurement of snow; 14°. International meteorological tables; 15°. Modification of the rules for the administration of the international committee. Any meteorologists intending to submit to the committee remarks on one or the other of these questions, or to propose other questions, can address Mr. Robert H. Scott, Meteorological office, 116 Victoria Street, London.

— The French Academy of inscriptions and belles-lettres offers the Bordin prize in 1887 for the best treatment of the subject, 'A critical examination of the geography of Strabo.' Competitors are invited, 1°, to review the history of the constitution of the text of the work; 2°, to compare the language of Strabo with that of contemporaneous Greek writers, such as Diodorus Siculus, etc.; 3°, to classify the original observations of Strabo, and segregate them from such as are merely quoted by him from other authorities; 4°, to draw such definite conclusions as the above-mentioned studies may suggest. The memoirs, under the usual conditions, should be deposited with the secretary of the academy at Paris by the 31st of December, 1886.

— The fifth German geographical congress was held at Hamburg, April 9–11 last, under the auspices of a local committee.

— A meeting of the American metrological society was held at Columbia college on Wednesday, May 20. Several interesting communications were made.

— The *Geographisches jahrbuch* (Gotha), now edited by H. Wagner since the death of its founder, Behn, will hereafter appear in two annual parts, with alternating contents, instead of as a single volume every two years, as heretofore. The part of volume x. just

issued contains reviews of physics of the earth, by Zöppritz; geographic meteorology, by Hann; European geodesy, by Oppolzer; geography of plants by Drude, of animals by Schmarda; and ethnological investigation, by Gerland. It is as indispensable as the earlier volumes to those who wish the broader view of these comprehensive subjects.

— The following temperatures and specific gravities of surface water in the Mississippi River were taken on March 1 and 2, 1885, from the South Pass to the mouth of the river, by the officers of the U. S. fish-commission steamer Albatross. From 7 P.M. of March 1, to 3 A.M. of March 2, the course of the ship was S.E. ¾ E., with a speed of 8.2 knots.

Hour.	Locality.	Corrected tempera-ture, F.	Specific gravity re-duced to temperature of 60° F.
5 P.M.	South Pass . . .	41°	1.00136
5.30 "	Jetties	41°	1.00136
6 "	Off Jetties . . .	54°	1.01039
7 "	" " . . .	58°	1.01413
8 "	" " . . .	58°	1.01495
9 "	" " . . .	62°	1.01514
10 "	" " . . .	57°	1.01820
11 "	" " . . .	58°	1.01989
12 M.	" " . . .	64°	1.02564
1 A.M.	" " . . .	65°	1.02714
2 "	" " . . .	66°	1.02754
3 "	" " . . .	61°	1.02809
6.27 "	Lat. 28° 00′ 15″ N. Long. 87° 42′ 00″ W.	66°	1.02823
8 P.M.	Lat. 28° 05′ 00″ N. Long. 87° 56′ 15″ W.	66°	1.02819

— Capt. Magee of the schooner Henry Waddington reports that he passed close to a white whale on March 1, in latitude 27° 3′ north, longitude 75° 30′ west. This position off the Bahamas is unusual, as the white whale is usually found in northern waters. The portion of the whale seen was entirely white, and about thirty feet long.

— Dr. Klein has been experimenting with chlorine as an air-disinfectant, especially in respect to swine-disease, this being easily conveyed by the air. He experimented with two pigs — one healthy, the other diseased — confined in the same stable, and in an atmosphere impregnated with as much chlorine as the animals could endure without evincing discomfort. The healthy pig remained well for as long a time as six hours, for five successive days, provided the air in the compartment was maintained well-fumigated with chlorine gas; two good fumigations, up to a marked pungency in the six hours, being required. One good fumigation would effectually disinfect a compartment in which a diseased pig had been.

— A new map of north-western Afghanistan, on the larger and more convenient scale of ten miles to the inch, has been issued by the English war office.

— The increase in the price of boxwood for loom-shuttles has directed attention to the possibility of producing some cheaper material equally suitable. It has been found that compressed teak will answer the purpose; and a powerful hydraulic press has just been completed by Sir Joseph Whitworth of Manchester, Eng., for Mr. Robert Pickles of Burnby, to be used in compressing this class of timber for the manufacture of loom-shuttles.

— Baron Miklouho-Maclay writes to *Nature* from the biological station near Sydney, Australia, that he has found the temperature of the body of Echidna hystrix to be (average of three observations) 28° C., and that of Ornithorhynchus paradoxus (two observations) 24.8° C. These temperatures present a special interest, comparing them with the mean temperature of the body of mammalia in general, which is (after Dr. J. Davy's observations of thirty-one different species) 38.4° C.

— The hydrographical researches in Davis Strait, says *Scandinavia*, further corroborate the evidence that there exists in this place a warm undercurrent; for it was found that the highest temperature, when the depth is more than a couple of hundred fathoms, is nearest the bottom. The results of the haulings and scrapings, extending to a depth of three hundred fathoms, in Davis and Disco Bays, were many varieties of lower animals, a few of which were new species. Davis Strait is a favorite ground for deep-sea dredging; for on the 28th of June, 1845, Henry Godrey, a member of the Sir John Franklin expedition, obtained in Davis Strait, from the depth of three hundred fathoms, a capital haul, — Mollusca, Crustacea, Asterida, etc.

— Dr. Leonard Weber published in the *Elektrotechnische zeitschrift* a paper on the estimation of the illumination which a light of any given strength would give upon a table, or on a wall, or any other object which it might be desired to illuminate; his point being to consider not only the intensity of the source of light, but also the position in which the light should be placed to render it available to the highest degree.

— Woeikof of St. Petersburg contributes to the Geneva *Archives des sciences* a sample chapter in French from his recent work in Russian on climatology, describing the supply and discharge of the rivers and lakes of Russia. The most characteristic examples of river-discharge of the Russian type include such rivers as the Volga, Kama, and Moskva, which rise to high flood regularly once a year in April or May, when the winter snowfall melts and flows away. The Moskva, which has been carefully gauged in recent years, discharged 93,000,000 cubic metres in the twenty-five days from April 16 to May 10: during the rest of the year, the total discharge was only 85,000,000. The Neva, a lacustrine river, is, of course, much more regular in its flow: it carries out about one-eleventh of the volume of Lake Ladoga every year. Evaporation on the Caspian is estimated at a little over a metre a year, but fine exactness is not claimed for this result.

— The long series of experiments made during last summer and autumn at the South Foreland light, England, to test the respective merits of oil, gas, and electricity, for lighthouse illumination, will shortly be

reported. The result is strongly in favor of electricity. The electric light could be seen fourteen miles when the others were lost sight of at eight miles; and, when the others were at a maximum power of ten miles, the electric light could be seen at fourteen and a half; and, though its power is much diminished by fog, it is still superior to all other lights, — a point hitherto doubtful.

— In consequence of the increase of shortsightedness, and the theories current as to its cause, a new departure in book-printing has been made in Holland, the letters being printed in dark blue on a pale-green page. Messrs. Issleib of Berlin have also printed one of their latest publications, 'Die naturgeschichte der Berlinerin,' in this manner, but the result is not wholly satisfactory.

— *Scandinavia* states that H. C. Muller, who, as 'Sysselmand,' has been present at a large number of 'drivings' of whales at the 'Faroer,' has recently described, in the Proceedings of the Natural-history society at Copenhagen, the process of catching the grindehval. The largest number are caught in the months of June, July, August, and September. A few wounded specimens are found to be troubled with parasites, small white crustaceans, rarely by cirripedes. It has an enemy in Delphinus orca, the marks of whose teeth have often been observed on it; but that Lagenorhynchus Eschrictii or Delphinus turrio should bite it, is a fable, for its mouth is too little and its teeth too small to do the grindehval any harm. Besides, it feeds on the same food as the grindehval, viz., squids. The news of the arrival of the whales spreads like fire. From every village people hasten to the place. By throwing stones the whales are driven into the bay, whence they are either dragged on land and killed, or slain with knives on the shallow places. Then, after the whales have been killed, a division of the catch is made by the participants, certain portions being reserved for the state, church, and school funds.

— Professor Kiessling of Hamburg has given especial attention to the famous sunset question, and during the past year has devised a number of experiments for illustrating the action of minute solid or liquid particles on sunlight, by which sky colors are produced. He has lately summarized his results in a pamphlet entitled 'Die dämmerungserscheinungen in jahre 1883 und ihre physikalische erklärung.' Diffraction is considered the most important optical process that contributes to the result, as the dull reddish ring around the noonday sun, the horizon colors at sunset, and the purple and other glows half an hour later, are all ascribed to this action. The explanation of the purple and pinkish glows is especially apt and ingenious, and more to the point than any other solution of the question that has been presented. An important supplement to his pamphlet describes the construction of an apparatus designed to illustrate his explanations experimentally. He is a strong supporter of the volcanic origin of the particles on which the diffracting water-particles have condensed.

— We learn from *Scandinavia* that Professor Falbe Hansen of the University of Copenhagen delivered recently a very interesting lecture upon the progress of Denmark in recent times, especially after the free constitution of 1848. During the last century, the yearly increase of the population was nearly 2,000; after 1840, 17,000. Copenhagen had, in 1840, 124,000 inhabitants, while it now has 330,000. The provincial towns rose in the number of its inhabitants from 148,000 in 1848, to 304,000. Early in the century, at the accession of King Frederick VI., the national wealth could be computed at 530,000,000 crowns; in 1848, at the accession of Frederick VII., at 1,000,000,000; at his death in 1863, at 2,300,000,000; and now, at 4,000,000,000. Denmark cannot any longer justly be named, as formerly by the poet, 'a poor little country.'

— Miss E. A. Ormerod has just issued her eighth annual report of "Observations of injurious insects and common farm pests during the year 1884, with methods of prevention and remedy." It embodies the remarks of numerous observers in various parts of Great Britain on the occurrence of insects injurious to farm and garden crops, on their habits, and on the best ways of getting rid of them. It is not a little remarkable, says *Nature*, to notice how observant, often of minute and interesting details, Miss Ormerod's correspondents are; and, though many of them probably have little or no scientific training, their aptitude for studying the habits and effects of certain insects makes their records of considerable value. Aside from the scientific interest of the report, Miss Ormerod has done a good work in inculcating habits of observation among farmers and gardeners, who have opportunities such as few others have for noticing facts connected with the life-histories of insects.

— In the January number of the *Journal of anatomy and physiology*, Dr. Alexander Hill describes a very interesting parasitic monster which he recently dissected. The parasitic twin consisted of a lobulated mass projecting from the anterior nares of a more perfect foetus. The mass is about as large as the head of the other foetus, and is divided into three large and six small cotyledons. In one of the large lobes there is an embryonal form of liver; in another a central irregular mass of bone, full of cysts. From a study of this parasite, Dr. Hill concludes that the foetus is a double monster, one part of which has been arrested in development by some mechanical advantage which the more perfect foetus possessed over the other in the beginning; and that the parasite did not begin to develop until after the perfect twin was rather far advanced. The parasite is well supplied with blood, and the skin is well developed; but the larger part of its mass is made up of jelly-like embryonic tissue.

— A German engineer is reported to have invented a method of ascending and descending in a balloon at pleasure until he finds a current of air moving in the horizontal direction he wishes. The agent he uses is compressed carbonic acid, with which he is enabled to condense or expand the gas.

SCIENCE.

FRIDAY, JUNE 5, 1885.

COMMENT AND CRITICISM.

The April issue of the *Zoophilist* is very much a Baltimore number, from the space given to Professor Martin, and to the 'martyrdom' of Prof. J. Rendel Harris. Professor Martin's reply to some strictures made upon his work in an earlier issue of the same journal is treated as 'an angry, exaggerated, and absurd pamphlet' by various writers. We have already made, as we believe, suitable mention of the pamphlet in question, but return to the controversy again because the *Zoophilist* offers so clear an illustration of the unfair and ungenerous methods which find favor with the antivivisectionists. Many of these persons hold views, such that, however much we may disagree with them, they are entitled to respect — and silence. When, however, any person having 'views' is not only unable to perceive that an opponent may be equally earnest and upright, but also uses the press to show him up as a prevaricator, or, more plainly, as a liar, it is time for self-respecting persons to speak out.

The points in the discussion are briefly these: Professor Martin published some experiments which physiologists, and other medical men familiar with experimental work, — i.e., those persons most competent to sit in judgment thereon, — consider a valuable addition to our knowledge of the working of the animal body both in health and disease. In his account of his work — written for these same competent observers, and published where perfect candor and fulness are a matter of professional honor, so to speak — it is expressly stated that these animals were all put under the influence of undoubted anaesthetics or narcotics, except in two instances, where curare was used in order to be certain that the other drugs had not injured the organ under investigation. The *Zoophilist* people claimed, that, as he used artificial respiration in every experiment, he must also have employed curare in those other cases where it is not mentioned, and made other statements concerning the investigations, which show that a knowledge of some of the most elementary principles of physiology is sadly wanting in the editorial rooms of that paper. The effort to fall back upon information furnished by 'an eminent physiologist' would inevitably result in making him ridiculous, if the mention of his name could be permitted. Professor Martin's reply clearly set forth the nature of the operations performed, and especially the necessity of the tracheotomy and artificial respiration, since he wished to rapidly kill every organ except the lungs and the heart. The *Zoophilist* returns to the attack; but this is a mere reiteration of its former absurdities, with some added excrescences suggested by fresh and perverse misunderstandings of Professor Martin's explanations.

This may, perhaps, seem a trifling matter, but such it is not. Everywhere else, when divergency of views exists, opponents certainly agree to consider each other honest and frank. Such odium as their experimental work may call forth from the unthinking or ignorant mind, and more especially from the feminine type of it, the physiologists can readily endure, but they do fairly claim the right to be looked upon as men of at least as much candor and uprightness as those who oppose their research and yet expect to be classed among the educated and thoughtful. It is the duty of all workers in the different fields of science to stand together in such things, and to insist upon fair and just treatment from these ignorant critics who have the ear of that portion of the public with whom feeling and sentiment are on an equality with knowledge, and abusive misrepresentation passes for argument.

MR. R. A. PROCTOR attempts to explain how earthquakes are caused, in the June number of *Harper's magazine*, and attributes their energy to the action of interior heat on percolating water, and their opportunity to the time of changing pressures caused by atmospheric or tidal loading and unloading of the sensitive crust of the earth. Formidable numbers represent the tons of air or water brought on or taken off certain parts of the earth's surface in the passage of cyclones and anticyclones, and in the rise and fall of tides: but it may be strongly questioned whether these changes of pressure are very effective in determining the time of earthquake snaps; for the changes are gradual and short-lived, the pressures are relatively light, and the surfaces on which they have effect are so broad that the extremely small deformation needed for adjustment of equilibrium might be produced without any cracking or snapping. The omission of clear reference to orogenic earthquakes in such an article is very unfortunate, for Mr. Proctor will have many readers who take him for an authority on such matters; and, in the present attitude of seismology, the orogenic theory is certainly strongly supported by those who give the study the closest attention. It is rather remarkable to find no reference to gravitative distortions of the earth's crust, except in explaining the heat of the interior, after Mallet's method, and no mention of earthquakes following the making of cracks that are freely assumed as the passages by which water enters the subterranean regions, there to be exploded into steam.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Real and imaginary Americanisms.

IN the *verbatim* report of Sir William Thomson's famous Baltimore lectures occurs the expression, "and that is why I cannot get the electromagnetic theory." To this, Mr. George Forbes, in his commentary in *Nature* for April 30, appends a footnote: "These reports are generally quite *verbatim;* but I am sure Sir William Thomson is not responsible for this characteristic Americanism." Is it not, rather, a Scotticism? It is no Americanism at all. Although an American of long standing and considerable observation in such matters, I never heard 'get' by itself used in the sense of 'comprehend' or 'understand.' To 'get hold of,' is a not uncommon colloquial form. But in the same paragraph Mr. Forbes passes unnoticed a real and most prevalent Americanism: 'I do not think I *would* like to suggest,' etc. And again, at the close of the lectures: "I *would* be most happy to look forward to another conference." This substitution of 'would' for 'should' we should charge to the reporter, and feel sure that he was born west of New England and New York, where the just distinction between 'will' and 'shall,' 'would' and 'should,' is innate, while it is lost farther west and south. But the confusion is reaching England, as some recent books and newspapers show. I do not believe that Sir William Thomson has caught the prevalent epidemic, much as he has been in the affected districts. A. G.

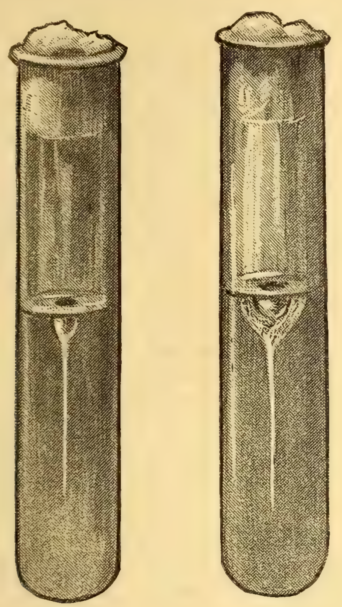
The cholera bacillus.

The exact *rôle* of the 'comma bacillus' in the etiology of cholera Asiatica remains unsettled. Arguments for and against the conclusions of Koch are perhaps equally strong on both sides, as evidenced by the discussions in the conferences on cholera held in Berlin, Munich, and London. Inoculation which completes the chain of evidence required to make good Koch's case, has in his hands, and in those of Nicati, Rietsch, Ermengen, Babes, and Watson Cheyne, produced positive results. Dr. Crookshank of King's college hospital, London, who has been working in the bacteriological laboratory here, and to whom I am indebted for the accompanying drawings, tells me that in Babes's cases three guinea-pigs, out of six

FIG. 1. — SECTION OF INTESTINE IN CHOLERA SHOWING KOCH'S BACILLI IN THE SUPERFICIAL LAYERS.

inoculated in the duodenum, presented the lesions of cholera; and pure cultivations of the bacillus of Koch were obtained from the intestinal contents. Koch has just introduced a new method of operation without the production of any external lesion, and he reports the cases as completely confirming the view of the pathogenic nature of the bacillus. Klein and Gibbs have denied the existence of the cholera bacillus in the intestinal tissue. On the other hand, since Koch's original proof, they have been demonstrated by Babes, and confirmed by Crookshank, by staining the sections after the method introduced by Babes (*vide* figure). This consists in cutting very thin sections in close proximity to a Peyer's patch, placing it in an aqueous solution of good fuchsin for twenty-four hours, washing in a sublimate solution (1–1000),

passing rapidly through alcohol and oil of cloves, well drying with pressure of blotting-paper folded four times, and mounting in Canada balsam. In its



a. b.

FIG. 2.—CULTURE OF KOCH'S COMMA BACILLUS OF CHOLERA IN NUTRIENT GELATINE.

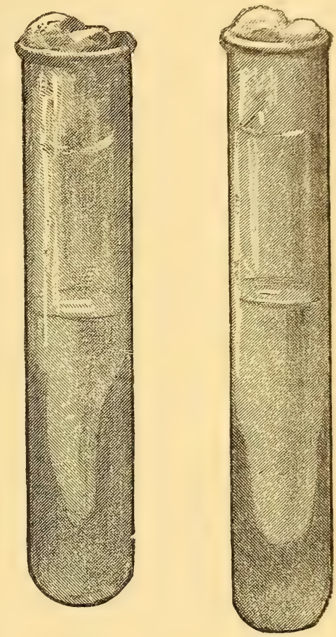
a, second day; *b*, fourth day.

biological characteristics, Koch's bacillus differs from that of Finkler and Prior, as will be seen from the following table:—

Koch's bacillus.	*Finkler's bacillus.*
Plate-culture.— Colonies faintly golden red; irregular, indented margins.	*Plate-culture.*— Colonies liquefy gelatine much more rapidly; faint, brownish-yellow tinge; larger and rounder margin, well defined.
Tube-culture.—Fig. 2, puncture in nutrient gelatine. Liquefaction commences slowly at upper part of needle-tract; forms a funnel-shaped excavation enclosing a bubble of air; lower part of needle-tract resembles a white thread, and remains so for several days.	*Tube-culture.*—Fig. 3, puncture in nutrient gelatine. Liquefaction more rapid; extends along whole length of needle-tract, and forms a conical, misty culture, gradually resembling the finger of a glove turned inside out.
Surface-culture.— (Agar-agar). Forms semi-transparent, white plaque; liquid at bottom of oblique surface; becomes milky.	*Surface-culture.*— (Agar-agar). The same forms much more quickly; and in addition, after a certain time, a characteristic coffee-colored stratum appears at the bottom of the liquid.
Potato-culture.—Only grows at temperature of the blood (37° C.), forming a transparent, slightly brownish layer.	*Potato-culture.*— Grows at ordinary temperature; culture brown, with whitish margin. Surface of potato appears corroded.

Babes and Crookshank have examined over one hundred pure cultures of Koch's bacilli of various ages and on various media. The round bodies frequently found, either alone, or accompanying filamentous and irregular spirilliform developments of the comma bacilli, were found in all cases to be perfectly sterile. At the recent meeting at Munich, von Pettenkofer and Emmerich bitterly opposed Koch's conclusions, and asserted that his bacillus had never been found in the mucous membrane of the intestine. The drawing here given, taken from a section of intestine of a patient who died of Asiatic cholera, and prepared by Babes and Crookshank,—a preparation which I have seen many times,—is rather damaging to the Munich school.

I have several cultivations of the Finkler, Prior, and Koch bacilli under observation, and the biological and morphological characteristics of each are distinct and sharply defined.



a. b.

FIG. 3.—CULTURE OF FINKLER AND PRIOR'S COMMA BACILLUS OF CHOLERA NOSTRAS IN NUTRIENT GELATINE.

a, second day; *b*, fourth day.

Raptchievski (Wratch., 1885, No. 7) reports an interesting case from St. Petersburg. A microscopic examination of the dejections showed, 1°, long and narrow bacteria, as found by Bienstock (*Zeitschr. klin. med.*, vol. viii.) in normal fecal matter, such as produce putrefaction in albuminous matter; 2°, chains of oval micrococci, similar to the microbes found by the French commission (*Archives de physiol.*, 1884, No. 4, pl. 11, fig. 6); 3°, a bacillus exactly similar to that described by Koch; 4°, another in greater quantity, found by Finkler and Prior in cholera nostras. HORATIO R. BIGELOW, M.D.

Berlin, Germany, May 5.

The reddish-brown ring around the sun.

The ring of reddish-brown color surrounding the sun, and enclosing a disk of glowing whitish light, to which Prof. G. H. Stone called attention in *Science* for May 22, p. 415, has been most carefully studied by Kiessling of Hamburg, who has shown clearly that it is due to diffraction on minute particles suspended in the air. Careful observers agree that it was not seen before November, 1883; but since then

it has attracted much attention. It is manifestly produced in the upper regions of the atmosphere; for it is best seen from elevated mountains, where it is continually visible in clear weather. It is often hidden at low stations by the plentiful reflected skylight that comes from the coarser dust of the lower atmosphere, even though the sky seem tolerably clear. It has been astonishingly distinct here in Cambridge through the past winter, on the clear anti-cyclonic days, with north-west winds, following the withdrawal of the cyclonic cloud-disk; and it attains its greatest visibility between clouds, because much of the lower dusty air is then in shadow, and does not outshine the delicate colors of the ring. On some recent cloudless but slightly hazy days it has been entirely invisible.

I have not observed the connection between the visibility of the ring and the changes of temperature and formation of clouds noted by Professor Stone, and should be glad to learn more details as to date of observations, and as to closeness of the connection in point of time. A comparison of observations on these questions made at Colorado Springs (where I presume Professor Stone made his records) and on the summit of Pike's Peak would be very instructive in this respect.

The most remarkable point in connection with the ring is its persistence long after the cessation of the brilliant twilights with which it began. How is the volcanic dust or the ice dust that causes it supported so long? It seems incredible that dust could simply float for a year and a half in so thin a medium as the atmosphere at a height of ten or more miles. Electrical repulsion has been suggested as a supporting force, and it may be somewhat effective above the level of storm-circulation; but, besides this, it seems possible that the peculiar properties of water-vapor may give some aid. Wollaston long ago speculated on the limitation of the atmosphere at an altitude where its gases were frozen. The solid particles would there fall till evaporated, when the gases thus formed would rise again till frozen once more by the cold of expansion. Ritter and others have recently reconsidered this process. Whether the theory is applicable or not to oxygen and nitrogen, it certainly is of importance when water-vapor is considered: for, as is well known, the elasticity and condensibility of this constituent of the atmosphere are mutually antagonistic. The vapor tends to diffuse itself to altitudes where the cold caused by its expansion would require the condensation of a part of it; and, although such perfect diffusion is prevented in the lower atmosphere by the friction that the vapor suffers in passing through the air, it does not seem unreasonable to believe it may obtain at great altitudes where a normal distribution of vapor must be more nearly attained, and especially so at times when an extra supply of both vapor and dust is shot high out of volcanic craters. We may therefore believe that at some high level the atmosphere is 'saturated' with vapor: above this there will be continual condensation, supplying a delicate shower of the minutest ice particles; and, if these really need a solid nucleus to freeze upon, the nuclei may be sustained by the continuous upward diffusion of the vapor that rises to take the place of that which has been condensed, only to be condensed itself in its turn. Kiessling's discussion of the diffractive action of particles suspended at considerable altitudes fully accounts for the twilights and the solar ring; and the close agreement in date of occurrence of several great volcanic explosions, and subsequent brilliant twilight displays, naturally leads to the acceptance of the volcano as the source of the diffracting matter. Perhaps the Wollastonian idea may aid in explaining the remaining difficulty; namely, the long-continued suspension of some of the diffracting matter in the upper atmosphere.

W. M. DAVIS.

Cambridge, May 24.

Life.

In the brief abstract in *Science* (May 8, p. 386) of my address on 'Life,' at the celebration of the semicentennial anniversary of the Lyceum of natural history of Williams college, I am credited with the following statement: "Kick a stone and a dog: the difference in the result *is caused* by education."

The words are printed in quotation-marks, as if they were my own; and, as a friend tells me that they seem to him to imply a belief that life has been produced by the education of dead matter, and that a stone might be educated into a dog, I hope you will give me space to say that the words are not mine.

Beyond the quotation, with approval, of Huxley's statement, — that "for us, at least, the distinction between living bodies, and those which do not live, is an ultimate fact," — the address contained no opinions regarding the origin or cause of life. It was devoted to the presentation of a definition; and I tried to show, first, that education makes us acquainted with the order of nature, and thus enables us to use one event as the sign of another which is to follow, and to regulate our actions according to the laws of nature; and secondly, that, since all living things respond to the order of nature in the same way, they also are educated; and that education, or the ability to make such responses, is life.

The writer of the abstract in *Science* had no opportunity to consult my manuscript, but I believe that the sentence which I have quoted is from his notes on a passage which reads as follows: "The actions of the dog are significant. They stand in relation to the external world, and their *meaning* could never be learned from the study of the dog's body, but must be sought in his environment, and that of his ancestors. The real difference between living and dead matter lies in this *significance* of the actions of living things. This is what we really mean when we say that the dog is alive, while the stone is not."

W. K. BROOKS.

EBENEZER EMMONS.

PROFESSOR EBENEZER EMMONS was born at Middlefield, Mass., May 16, 1800,[1] and died at his plantation, Brunswick county, N.C., on the 1st of October, 1863.

He was prepared for college at Plainfield, Mass., under the Rev. Mr. Halleck, entered Williams college at the age of sixteen, and was graduated in the class of 1820.

As a surgeon, Dr. Emmons ranked high in his profession, and for fifteen years was the most eminent practitioner in Berkshire county. He was appointed professor of chemistry at

[1] His birth has been variously stated as in 1798 and 1799; but he always stated to his children that he was born in 1800.

the Albany medical college in 1838, and was afterward transferred to the professorship of obstetrics, his connection with the college continuing until 1852.

Dr. Emmons's chief claim to remembrance lies in his work as a geologist. A favorite pupil of Professor Amos Eaton, he soon became interested in the mineralogy and geology of the western part of Massachusetts, and the adjacent region of the state of New York. Appointed professor of natural history at Williams college in 1833, he held that position till 1859, when he became professor of mineralogy and geology, an office which he held until his death in 1863.

His appointment as geologist of the second district of the geological survey of New York in July, 1836, gave the opportunity for the exercise of his power of acute observation in the field, which made his great reputation as a geologist. In 1837 Dr. Emmons first named, described, and classified the celebrated 'Potsdam sandstone.' In 1842 he pointed out a great system of stratified rocks under the Potsdam, which he called the 'Taconic system.' Two years later Dr. Emmons first described the primordial fauna, preceding the celebrated discoveries of Barrande, who recognized Emmons's right of priority in the following very courteous manner: "In comparing these dates, it is clear that Dr. Emmons was the first to announce the existence of a fauna anterior to that which had been established in the 'Silurian system' as characterizing the 'lower Silurian' division, and which I have named the second fauna. It is, then, just to recognize this priority, and I think it all the more fitting to state it at this time, that it has not hitherto been claimed." At a later date Emmons published further details, and described several other primordial fossils in his 'American geology' and 'Manual of geology' in 1855 and 1859.

The following familiar names, divisions, and classifications, of the paleozoic rocks of New York, are also due to Emmons: Chazy limestone, black marble of Isle la Motte, Lorrain shales, Champlain group, Ontario group, Helderberg series, and Erie group.

In 1851 Dr. Emmons was appointed state geologist of North Carolina. His discoveries in the coal-measures of Deep and Dan rivers, of a splendid triassic flora, with old vertebrates, such as fishes, saurians, and finally of the oldest mammal (Dromatherium sylvestre) yet found, not only in America, but in the whole world, are justly counted among the most important

contributions to the progress of American geology. Indeed, his description of the new red sandstone flora of North Carolina is so valuable, that the U. S. geological survey has recently reproduced the descriptions and all the plates given by Emmons in the sixth part of his 'American geology.'

Although educated in accordance with the Puritan discipline of the old New-England pattern, Professor Emmons was of a cheerful and most amiable disposition, and was respected and beloved by all who came in contact with him. I cannot better finish this too short notice of one of the greatest pioneers of American geology, than by quoting the opinion of one who was acquainted with him during his whole life, the respected and beloved Rev. Mark Hopkins, long president of Williams college, who says, "Emmons was a man of remarkable powers and great accuracy of observation. He seemed to have an intuitive perception of the differences in natural objects. He possessed an intense enthusiasm in his work, but in his manner was remarkably quiet. I have never seen the two things combined to the same extent. His perseverance knew no limit. It ought to be added, that, in connection with his science, he was deeply religious. Williams college is greatly indebted to him for its collections in natural history."

JULES MARCOU.

THE ROYAL SOCIETY OF CANADA.

THE fourth annual meeting of the Royal society of Canada took place last week in Ottawa. The proceedings extended over four days, beginning on Tuesday the 26th; and the attendance of members and delegates was, on the whole, very satisfactory, though not quite equal in number to that at the last meeting. Of fellows, about forty were registered, while thirteen affiliated societies were represented by delegates.

Tuesday was entirely devoted to the general meeting of the society, the morning being occupied by formal business and the reception of reports from delegates and committees; the afternoon, by the addresses of the president, Dr. T. Sterry Hunt, Vice-Presidents Dr. D. Wilson and Hon. P. J. Chauveau, and his excellency the marquis of Lansdowne as honorary president. Dr. Hunt, in the course of his address, took occasion to urge strongly the utility of the establishment of accurate tidal observations on the coasts of the Dominion, while the vice-president, in reviewing the work of the society, pointed out the special necessity of immediate effort in connection with ethnological research.

The society is divided into four sections, — two dealing with French and English literature, history, and allied subjects, respectively; one with mathematical, physical, and chemical sciences; and one with geological and biological subjects. Over thirty papers, in all, were presented; the meetings of sections going on simultaneously, and occupying the greater part of the time on Wednesday and Thursday. The papers of a purely literary or historical character scarcely fall within the province of this journal. The following notes embrace merely the salient points of some of the more important or novel scientific communications: —

In a paper on the mesozoic floras of a portion of the Rocky Mountain region north of the 49th parallel, Sir William Dawson referred specially to a remarkable Jurasso-cretaceous flora recently discovered, which occupies a stage much lower than the Dakota beds, and gives evidence of a great basin of lower cretaceous rocks in that part of the north-west. The paper was illustrated by a suite of specimens. A second paper by the same author related to certain new points in the geology of Prince Edward Island, and the correlation of the rocks of the island with the Permo-carboniferous, Permian, and triassic, as proposed by Mr. Bain. Mr. G. F. Matthew contributed a third part of his investigation of the Cambrian fauna of the vicinity of St. John, N.B., indicating the division of the Cambrian into several subordinate series, the relations of which, with their European and other equivalents, were discussed. In the Rev. Dr. Honeyman's essay on the geology of M'Nab's Island, Halifax, a point which gave rise to some discussion in the section was the described occurrence of glacially transported fragments of trap rocks like those of the Bay of Fundy. These must have been carried across the entire width of the peninsula of Nova Scotia. Prof. E. J. Chapman gave the results of a close examination of the Wallbridge hematite deposit in Ontario, which he considered as typical of a large class of ore-deposits in that region, and proved to be an irregular mass or 'stock-work' penetrat-

ing the Laurentian strata. Mr. Thomas Macfarlane brought two communications before the society, but read them in abstract only. That on the much-disputed region in the south-eastern part of Quebec pointed out certain critical localities in regard to which additional investigation was desirable. Papers by Prof. Loring W. Bailey and Mr. William Saunders on the economic minerals of New Brunswick, and butterflies of Canada, respectively, being catalogues, were merely explained in general terms. Dr. G. M. Dawson described the Cambrian rocks met with by him in the Rocky Mountains north of the international line, and compared these with those of Nevada and the Colorado Cañon. Professor Ramsey Wright's note on the genus Hypophthalmus, was, in the absence of the author, read by title only.

In the physical and chemical section Dr. T. Sterry Hunt gave an exposition of his proposed new classification of silicates, dividing these minerals into three great groups. A second paper by the same author was on the geognosy of crystalline rocks. These are first considered, in relation to condition, as stratified or unstratified, and an endeavor made to define the limits of stratiform structure due to bedding and the flow of molten matter. A further development is then given of the crenitic theory. The author claims that the whole subject belongs essentially to chemistry and mineralogy, and that the speculations of geologists have rather obscured than elucidated the problems presented by the crystalline series. In continuation of a previous investigation, a paper was read by Prof. E. Haanel, describing certain blowpipe reactions on plaster-of-Paris tablets. These included a mode of detection of osmium with hydriodic acid, and of chromium, antimony, and molybdenum with terchloride of tin. Dr. H. A. Bayne outlined the results of a series of critical experiments on the best modes of determining analytically the amount of silk present in mixed fabrics. He recommended the employment of basic zinc chloride as a solvent for silk in the presence of wool, and of Lowe's alkaline glycerine solution of oxide of copper when silk is combined with cotton and linen fibres. Dr. A. Johnson read an elaborate paper on the best and most economical methods of establishing tidal observatories and investigating tidal currents, dealing particularly with the Gulf of St. Lawrence and eastern coast of Canada. Mr. C. Carpmael brought before the section a paper on the determination, in terms of a definite integral, of the value of the expression

$$\frac{1}{\lfloor m+n}\Big\{\left(x+\frac{n}{2}\right)^{m+n} - n\left(x+\frac{n}{2}-1\right)^{m+n} + \dots + (-1)^r\frac{\lfloor n}{\lfloor n-r\,\lfloor r}\left(x+\frac{n}{2}-r\right)^{m+n} + \dots + (-1)^n\left(x-\frac{n}{2}\right)^{m+n}\Big\},$$

the series to be continued only as long as the quantity raised to power $m+n$ is positive, n being a positive integer, and m a positive integer, zero, or a negative integer numerically less than n; and on the deduction therefrom of approximate values in certain cases. After pointing out that Cauchy's investigation fails when m is zero or a positive integer, although Cauchy had assumed without comment that it would hold, the author proceeds to investigate the values of certain 'extraordinary integrals.' The values obtained differ in most cases from those of Cauchy; but the final approximate values agree with them, if we correct certain numerical errors in his results.

In this section the following papers were also read: "On the introduction and rational interpretation of negative and imaginary quantities in the calculus," by Dr. D. Duval; "Note on the quantitative blowpipe assay of cinnabar," by Professor Haanel; "On the theory of M. Steckel," by Mr. C. Baillargé; "On some iron ores of Ontario," by Professor Chapman; "A commentary on section ix. of Newton's 'Principia,'" by Professor Cherriman; "The density of weak aqueous solutions of salts," by Professor McGregor; "On longitude determinations at Montreal," by Prof. W. A. Rogers and H. McLeod; "On Clausius' theory of the virial," by Professor Loudon.

Two important ethnological papers were read by Dr. D. Wilson in the section of English literature. The first, "On the manifestation of the aesthetic faculty in primitive races," discussed the evidence of this faculty, and the practice of imitative art among uncivilized peoples. The neolithic period in Europe showed an almost entire absence of such art; but, in the vastly more remote age of the cave-men of France, remarkable indications of it occur. The author compared these with evidences of the art of American aborigines, and stated his reasons for tracing all alike to efforts at sign-language, and ideographic expressions of facts and thought. Dr. Wilson's second communication pointed out, that, in the drawings of the cave-men of France, right-hand profiles are to those of the left-hand as about two to one. The proportion of left-hand drawings is greatly

in excess of what would now be found; but there is still a distinct preponderance of the right-hand, which, however originated, has sufficed to determine the universal dexterity of the whole historic period.

In the French literary section, Abbé Tanguay read a statistical paper on the French population of Canada from 1608 to 1631.

At the closing general meeting on the 29th, the election of several new ordinary members was confirmed, and Prof. T. G. Bonney was elected as a corresponding member. Dr. D. Wilson and Rev. T. E. Hamel were elected as president and vice-president for the next meeting.

PREVENTING COLLISIONS WITH ICEBERGS IN A FOG.

THE recent accident to the steamer City of Berlin emphasizes the importance of devising practical methods of ascertaining the proximity of icebergs in a fog. The precautions adopted by Capt. Laud, though they saved the lives of more than fourteen hundred passengers, and prevented serious damage to the vessel, did not prevent contact with the berg. Even the 'look-outs' were unaware of the proximity of the iceberg until it was actually upon them.

Under these circumstances, the method proposed by Mr. Frank Della Torre of Baltimore deserves consideration. His experiments indicate the possibility of obtaining an echo from an iceberg when in dangerous proximity to a ship. Mr. Della Torre believes that even an object offering so small a surface as a floating wreck may in this way be detected during a fog in time to prevent collision. However this may be, it is certain that his method is worthy of a careful trial at sea, and that preliminary experiments, recently made in the presence of Professor Rowland of Johns Hopkins university and the present writer, have demonstrated the feasibility of producing well-marked echoes from sailing-vessels and steamboats at considerable distances away.

These experiments were made on the River Patapsco, near the head of Chesapeake Bay, at a point about seven miles from the city of Baltimore. The party proceeded down the river in a steam-launch to the selected place, where the distance from shore to shore appeared to be about three miles.

The launch was kept so far from land as to prevent the possibility of mistaking an echo from the shore for one produced by a passing vessel.

The apparatus employed consisted of a musket to the muzzle of which a speaking-trumpet had been attached (see the illustration). This gun was aimed at passing vessels, while blank cartridges were fired. After a longer or shorter time, according to the distance of the vessel, an echo was returned.

The ordinary river-steamboats, and schooners with large sails, returned perfectly distinct echoes, even when apparently about a mile distant. At shorter distances the effects were, of course, still more striking.

In order to test the effects under the most disadvantageous circumstances, blank cartridges were fired in the direction of an approaching tugboat. The surface presented was, of course, much smaller than if the boat

had presented its broadside to the launch. As the boat approached bow on, it corresponded to a target somewhere about six feet square, presenting a convex surface to the impinging sound-wave. Even in this case a feeble echo was perceived when the boat was at a considerable distance (estimated to be nearly one-quarter of a mile). That any echo should have been perceived at all under such circumstances, was a surprise. The sound was heard only by the closest attention, but in the case of larger vessels the effects were very distinct and striking.

Experiments were made which demonstrated the fact that the speaking-trumpet attached to the gun was of material assistance in giving direction to the sound-impulse, and in intensifying the audible effect.

Mr. Della Torre claims that a steam-whistle or siren, combined with a projecting apparatus like a speaking-trumpet, will prove as efficient as the gun.

During the experiments on the Patapsco River, a curious rumbling effect, like the rolling of thunder, was often observed, which continued for some seconds. A similar sound was also noticed, as an echo from a well-wooded shore; but the effect alluded to above could not have been due in any way to the land, as the sound commenced immediately upon the firing of the gun, whereas the shore was distant at least a mile or a mile and a half.

The sound was probably due to the presence of ripples on the surface of the water, as the effect was much less marked when the surface was smooth. Such a sound might prove a disturbing element of importance in a rough sea, but would hardly be sufficient to prevent the detection of an echo from a large iceberg. Had shots been fired periodically from the bow of the City of Berlin, it can hardly be doubted that the presence of an obstacle ahead would have been discovered in time to prevent the collision that actually occurred.

ALEXANDER GRAHAM BELL.

SOME PECULIARITIES IN THE AGE STATISTICS OF THE UNITED STATES.

SHORTLY after the issue of the present census reports, attention was called to the peculiar fact that very many more persons were recorded as being just 20 or just 50 years old than were as being 19 or 49. It is easy to see that there ought to be more persons living at any one year of life than at the next, — more at 7 than at 8 years of age, more at 19 or 49 than at 20 or 50. Of all the infants less than a month old at the present moment, quite a large number will die before completing their first year; many of those then surviving will die before the end of their second year; and so on, there being fewer left in each year than in the preceding year.

But all this is true only when certain conditions are satisfied. The growth of the population, it is assumed, is by natural increase alone, or nearly so. The number of foreign-born inhabitants, for instance, between the ages 10 and 15, will be smaller (that of native Americans, of course, very much larger) than the number between the ages 20 and 25, because so very many of the immigrants are, on arrival, between 20 and 25 years old. So, too, a war, or an epidemic which is particularly fatal to persons between certain ages, might be the cause of an exception to the general rule, at least until the generation so affected had died out.

But the effect of any such circumstances on the census figures which are here dealt with, may, without hesitation, be regarded as insignificant. The preponderance of the number of persons at the ages containing round numbers, over the number at the age immediately preceding (this being rather an 'odd' number), must be ascribed to an entirely different kind of influence.

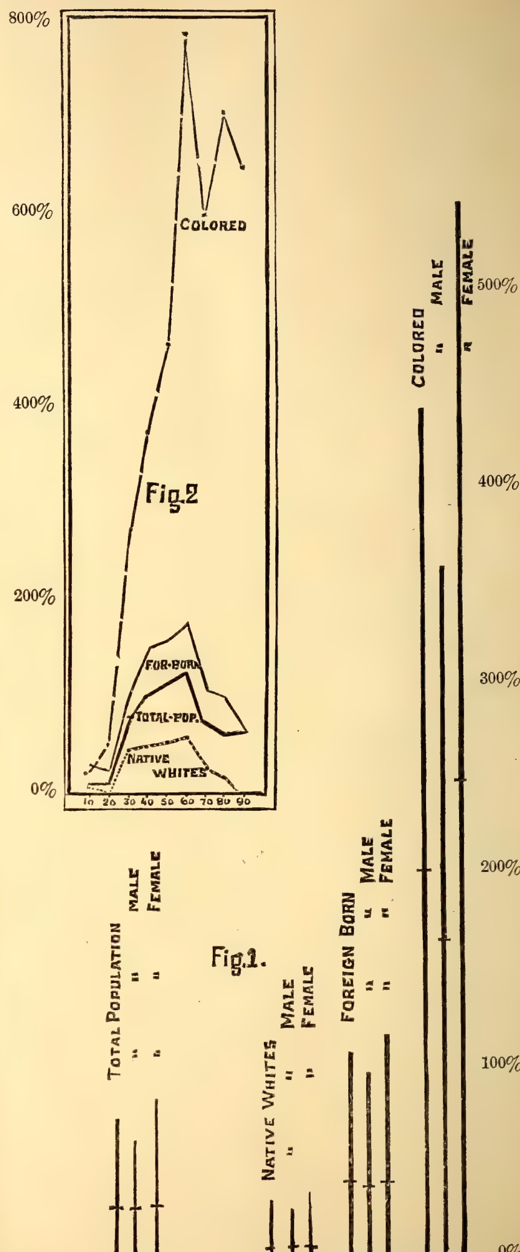
Before going farther, it is necessary to appreciate how enormous the attraction towards round numbers really is. Very naturally this attraction is greatest towards the ages containing multiples of 10, for then the numbers are 'roundest.' Subtract the number of persons recorded as 9 years old from the number recorded as 10, and express this excess in percentage of the number at 9 years. Do this for the excess of the number at 20 over the number at 19, of 30 over that at 29; and so on, the last being the excess of the number at 90 over the number at 89 years of age. The average of the 9 percentages thus obtained is what I will call the average '10 exaggeration,' any one of the percentages of which it is composed being spoken of as the '10 exaggeration' at 20 or 30 or 60 years, as the case may be. This average for the total population of the United States is $71\frac{1}{4}$ %; and the several percentages of which it is the average vary from 9.5 % to 126 %. This means, that instead of finding fewer persons recorded at any such 'round' age as 20, 30, etc., than at the age immediately preceding (19, 29), you would find, on the whole, nearly $1\frac{3}{4}$ times as many. You might find only $1\frac{1}{10}$ (an excess of 9.5 %)

as many if you happened to select 10, or even $2\frac{1}{4}$ times as many (an excess of 126 %) if you selected 60, as the age.

The comparison of this average '10 exaggeration' for the total population, with that for the native whites, the foreign-born, and the colored inhabitants, — making, in each case, the distinction between male and female, — will serve as a good starting-point. Fig. 1 expresses the result graphically. The first of each group of three lines shows the '10 exaggeration' of the total number of the class which it represents; the second line that of the male, and the third that of the female, portion of it. The first set of three lines represents these averages for the total population; the second, for the native whites; the third, for the foreign-born; the fourth, for the colored population.

The enormous exaggeration of the colored[1] people is the first striking, appalling fact. Their average '10 exaggeration' is 432 %: in other words, there are $5\frac{1}{3}$ times as many colored persons recorded at any age containing a multiple of 10 as at the preceding age. The native whites, as one would expect, are the most reliable class, their average excess being 28 %. The average of the foreign-born (103 %), while not in all strictness comparable with the others, may yet be considered so for our purposes. It is evident that the negro is the being upon whom all the various causes tending to produce this peculiar falsity of returns are the most active. The foreign-born are also very susceptible to these tendencies; and doubtless misunderstandings between the foreigner and the census official, owing to a meagre acquaintance with the language, enter as an additional disturbing influence. Moreover, in both these classes the general illiteracy is decidedly above the average.[2]

The next consideration is that of sex. The gentler sex in each case exaggerates more than the male sex, and, in the case of the colored people, considerably more. For the total population, the male average is 61 %, the female 81 %; for the native whites, male 22.5 %, female 33.5 %; for the foreign-born, male 92.6 %, female 113.8 %; for the colored, male 352 %, female 536.5 %. The average excess of the native white males (22.5 %), and that of the colored females (536.5 %), serve as a significant contrast. Next to the exaggeration at the ages containing multiples of 10, naturally comes that at the ages containing multiples of 5. This '5 exaggeration' follows the



same course with reference to race and sex as the '10 exaggeration,' and is represented in fig. 1. by the part of each line cut off between the cross-mark and the foot of the line. For the total population it is 26 %, as compared

[1] It should be mentioned that under this head are included the Chinese, Japanese, and civilized Indians; but the exclusion of these would not appreciably alter the results.

[2] I have traced out in detail the close relation between this '10 exaggeration' and illiteracy, which, however, would be too long to give here. A set of lines representing the illiteracy for the several races and sexes would closely resemble fig. 1.

with 71 % for the '10 exaggeration;' for the native whites it is 3 %, as compared with 28 %; for the foreign-born 36 %, as compared with 103 %; for the colored 200 %, as compared with 432 %.

If we subdivide the native male whites, the most reliable class, into the native male whites of each state and territory, we find great differences between the averages of the several states. The inhabitants of New Mexico, though native male whites, are in the habit of mendacity, at least Mexicans, and their '10 exaggeration' is 292 %. So, too, the native male whites of the southern states, where too close intimacy with the 'round-number loving' negro seems to be dangerous to statistical accuracy, have a high average; while all the New-England states are in the best third of the list, and all but Rhode Island in the best dozen. Other good states are Iowa, Ohio, Pennsylvania, Indiana, Minnesota, Wisconsin, and Michigan.

Having ascertained to what extent each race and sex exaggerates with reference to 'round-number' ages, it remains to trace the extent of this exaggeration at each of the 'round' ages. In this the graphic method will be an aid. The heavy line in fig. 2 represents the variations in the size of the '10 exaggeration' at the ages 10, 20, etc., up to 90 for the total population: the dotted line does the same for the native whites, the light line for the foreign-born, and the broken line for the colored. The distance from the point where the curve begins to the base-line measures the '10 exaggeration' for the number at 10 years; the distance from the point of junction with the second ordinate to the base-line measures the exaggeration for the age of 20; and so on, as indicated at the foot of the diagram. With the exception of that for the colored people, the curves are very similar. In each case, the ordinates are about as high at the point 20 as at the point 10; i.e., persons in the neighborhood of 10 years of age are about as apt to call themselves 10, as those in the neighborhood of 20 to call themselves 20, years old. After this point, however, the excess gradually increases for each decade, until the maximum is reached at 60. From 60 on, there is a more or less uniform fall to the last point at 90. But in the colored race the work of exaggeration is developed on a much vaster scale. Each decade has a higher excess than its predecessor, until, in this series of steep ascents, the apex is reached, as before, at the age of 60, when the excess is 930 %; that is, over 10 times as many colored people lay claim to the age of 60 as to that of 59. After the point 60, the exaggeration falls, but rises again at 80, ending with a slight fall at 90.

With regard to sex, as before, at each age (except at 10)[1] the females exaggerate more than the males: these differences are greatest at 70, 80, and 90 years.

It is natural that the giving of one's age in round numbers should be a more common practice with old than with young people. There is a greater difference between being 19 and being 20 years old than there is between being 59 and being 60. Younger persons, too, are more apt to know their exact age than older ones. The second half of each curve, then, is higher than the first half: this is especially evident in the curve for the colored people. But why this excess should be greatest at 60, is not apparent: 50 would probably have the strongest claim to be considered the '*roundest*' age. Or is 59 an '*odder*' number than 49? It seems that the condition of mind to which a round number is most apt to present special charms is most likely to occur near the end of the fifth decade of life. The age of 80, however, in the case of the colored people, plays almost as prominent a part as 60. The fact, too, that in the seventh, eighth, and ninth decades of life the greatest differences between the exaggerations of the two sexes occur, is interesting. It seems to indicate that old women, and notably old colored women, are far more forgetful of their ages than old men. For the colored males, the exaggeration at 80 is 520 %; for the females, 920 %.

If we were to trace similar curves for the '5 exaggeration,' we should find, 1°, that they would all be much lower (i.e., the exaggeration is less, as is also shown in fig. 1); 2°, that the curves would hold the same relative positions, — the native white lowest, then the total population, then the foreign-born, and much higher the colored; 3°, that the highest excess occurs at 45, except in the colored curve, where it is at 75; 4°, that the curves are less regular; 5°, that the exaggeration of the females is greater than that of the males, and differs most from it at the higher ages. It is peculiar that the greatest '5 exaggeration' occurs at 45, while the greatest '10 exaggeration' occurs at 60. The exaggeration at 65, however, is not much smaller than that at 45, and in the colored is actually larger, though here both are smaller than the excess at 75. This is what the 'roundness' of the number '75' would lead one to expect.

While in the '10 exaggeration' the second

[1] And here the difference between the sexes is very small.

half of the curve is higher than the first, in the '5 exaggeration' the two halves (except in the case of the colored people) are about equal. The '10 exaggeration' is thus rather a characteristic of old age, while the '5 exaggeration' is used by old and young.

There remains another peculiar irregularity of the census figures which deserves special treatment. It is the excess of the number of persons at 21 over those at 20 years. This excess is not of the same nature as the '10' or '5' exaggeration, and is due, of course, to political reasons; 21 being the voting-age, and 1880 the year of a hot presidential campaign: accordingly this exaggeration ought to occur in males alone. This is really the case. In estimating the size of this excess, we encounter a difficulty. To compare the number at 21 with the number at 20, would probably be comparing one exaggerated number with another; and, knowing that the number at 19 is too small, we cannot make a fair comparison with it. It is sufficient to notice, however, that there are always more males (and fewer females) at 21 than at 19, and, when the '10 exaggeration' at 20 is not large, more than at 20. Taking into consideration the excess at 20, we have to declare the native male whites (the most reliable class in the former exaggerations) as the class that exaggerates most at 21, — a conclusion quite natural, because they are most apt to be benefited by such falsity of returns. With regard to states, the inhabitants of the extreme west (Dakota, Wyoming, etc.) would rank as the worst, the New-England states as the best, under this head.

Whether this exaggeration is increasing or decreasing, is a question which unfortunately can be only very partially answered. Previous to 1880, the returns on age were given mainly in groups of five years. In 1870, however, all persons above 80 years of age were enumerated by single years. This makes possible a comparison between the excess of the number at 90 over that at 89 in 1870 and in 1880. This comparison is entirely in favor of the census of 1880. In this decade the exaggeration at this particular age (90 over 89) has fallen, for the total population, from 104.6% to 65.7%. As to sex, the male excess has fallen, from 87.1% to 36.7%; the female, from 118.7% to 90.3%. The colored people, too, have decreased their excess very greatly, — from 1267% to 647%. Two other peculiarities in the returns of 1870 may be noted: first, the difference between exaggerations of the sexes is less, disappearing entirely in the colored race; second, the excess in the native whites is exceptionally high, being 155.3%, while in 1880 there is no excess at all, but a deficiency of 4.8%.

The observation of such facts as have been here noticed, it is hoped, will shed light on the characteristics of the natural bias in favor of round numbers, as well as be a means of suggesting modifications in the method of questioning which would obviate these misrepresentations. It is just such irregularities that detract from the value of the census figures with regard to the calculation of the life-period, and expectation of life, in the United States. A more thorough comprehension of the questions treated above will doubtless be attainable from the census reports of 1890.

JOSEPH JASTROW.

CHOLERA INOCULATION.

A LETTER from Dr. J. Ferran of Tortosa (Catalonia) to the French academy (*Comptes rendus*, No. 15, 1885) contains some interesting assertions in regard to cholera and the cholera bacillus. He finds that cultures in *bouillon* at 37° C., carried on long enough to just visibly change the fluid, will, in doses of from two to four cubic centimetres, kill a guinea-pig.

At the point of inoculation appears a hot and painful tumor, which dries up and becomes detached, leaving an ulcer behind, which heals without pus formation or pain. The general symptoms are a rapid rise of temperature, bringing on a lowering of the physiological heat as taken in the rectum.

If a drop of blood be taken from an animal thus inoculated, and during life, and this drop be inoculated in *bouillon*, kept at 37° C., in from twenty-four to forty-eight hours a pure culture of spirilla will be obtained.

Microscopic examination of the serous effusion, coming after a blow upon the inoculated side, shows the following: —

1°. Extraordinary number of globules, so much so as to make one doubt the nature of what is being observed. Many of the red-blood globules have projections, and possess a real movement due to the striking of the microbes against these points. 2°. Spirilla and commas, almost invisible by reason of their rapid movements. 3°. Spherical cells full of granulations, some of them containing a granulation resembling a degenerated blood-cell. 4°. Lenticular elements, varying from five to twenty millimetres in size, and differing from the others described above.

A series of cultures in gelatine preserves its virulence, whilst a series in *bouillon* becomes attenuated after a certain time. If a series of guinea-pigs be inoculated with a quantity of the culture less than sufficient to kill them, they become capable of resisting doses which would before have been fatal, — a result which the writer claims he has obtained.

Effects of the microbe upon man. — The injection

of eight drops of a fresh, virulent culture in the region of the triceps brachialis produces a hot and painful swelling, which hinders the movements of the arm; following this comes a localized fever, which soon disappears; three hours after the injection, this phenomenon commences, continues about twenty-four hours, and then all effects disappear completely. If an injection of five-tenths of a cubic centimetre be made in each arm, the local symptoms are intensified, and general symptoms appear. These general symptoms bear an undoubted resemblance to true cholera; as, general coldness, rigors, lassitude, cramps, vomiting, dull mind, cold and clammy sweats, more frequent evacuations (but never reaching the true diarrhoea of cholera).

All of these symptoms are followed by a general rise of temperature, reaching even 2.5° C. above normal. More frequently there are more or less accentuated chilliness, general lassitude, dulness, desire to vomit, and fever. All of these symptoms cease at the end of from twenty-four to thirty-six hours, without necessity for a recourse to therapeusis. Sometimes they are more severe, and the blood from any part of the body gives the same microscopic appearances as in animals.

If, six or eight days after the injection of five-tenths of a cubic centimetre in each arm, the same dose, and of the same virulence, be injected into the same subject, the general symptoms do not occur, whilst the local phenomena are much less severe.

The writer draws these conclusions from his experiments, and offers to reproduce his results before the academy: 1°. "Cholerization is possible in man, as in animals, by hypodermic injection." 2°. "The prophylaxis of cholerization is obtained through graduated doses, or attenuated virus."

Dr. Ferran, no doubt to add weight to his paper, gives the names of twenty-four physicians, five medical students, five other males, and five females, upon whom he has experimented.

These experiments are said to have been carried on farther, but no proper report of them has as yet reached us Our criticism would be that the conclusion as to the efficiency of the inoculation against cholera, granting that the true bacillus of cholera was used, is an exceedingly hasty one, inasmuch as the protected (?) persons had not yet been brought in contact with the disease.

HERAT'S IMPORTANCE.[1]

THE reasons for the importance of Herat are of three kinds, — geographical, ethnological, and historical.

With regard to Herat's geographical situation, it will be seen at once that from Siberia to India, with the exception of the oasis in the Zerafshán basin, there is scarcely a point to be found which can bear comparison with Herat in regard to fertility and climatic advantages. Lying on the western and northern spurs of the Paropamisus Range, which is connected with the lower mountain range of Persia by the ridge of Siah-Bebek, the district of Herat is provided with an extraordinarily full river-system. Water, the most important auxiliary of agriculture in Asia, is therefore to be had in plenty; and the canals leading from the numerous water-courses, can, in consequence of the undulating surface of the district, be turned to account for irrigation in a very effective manner. Under the protection of political quiet, and with moderate industry, Herat could easily be turned into a garden; and that it frequently has indeed been a fruitful garden, whose manifold productions have awakened the envy of the neighboring powers, we have the testimony of history.

In regard to climate, Herat is equally favored. While with two degrees north or south the heat becomes unbearable, Herat enjoys a surpassingly mild climate, under whose influence the products of the north and the south ripen in equal perfection, and an agreeable habitation for mankind has always been provided.

It is no wonder, then, that the western district of Herat, commonly called Baghiz, was, even in antiquity, described by the geographers with enthusiasm. Ibn Haukal, Mukadassi, Edrisi, and others call Baghiz the 'crown of Khorasan:' the author of the geographical work 'Heft-Iklim' calls it a flower-garden of enchantment, with a thousand vales of trees and streams, — a camp-ground rich in grass and water, peculiarly suitable for the resting-place of the largest armies.

Indeed, this fame extends back even to pre-Islamitic times. Herat's wealth was proverbial; as witness the expression, "Khorasan is the mussel of the world, and Herat is its pearl."

As to the boundaries of this Baghiz, which to-day figures as the cause of the quarrel between England and Russia, they have been understood from the earliest times to be, on the west the Hari-Rud, and on the north the edge of the steppe, which, extending from Pul-i-Khisti to Shir-Tepe, marks the line between the cultivated oasis and the bottomless sand-desert.

In passing now to the ethnical features of Herat, it is to be noticed at the outset that it is exactly the miscellaneous character of the population which makes the work of conquest easy, and furnishes such means of civilization as would be sought elsewhere in vain. Among the million and a half inhabitants of Herat and its surroundings, the autochthonous Iranians hold the first place. For the most part, they are dwellers in towns, and have at all times distinguished themselves by their industry, perseverance, and special intellectual talent. It was they who produced so many brilliant periods of the Moslem culture; and the literary productions of the Herat writers, as well as the monuments of Herat artists and architects, are still subjects of admiration.

The population of the outlying districts bears the general name of Tshehar-Eimak, — i.e., four tribes, — and traces its origin back to the times of the Timurides. The former word is of Persian origin:

[1] From an article by H. VAMBÉRY in the *Oesterreichische monatsschrift für den orient.*

ZOLFIKAR PASS. (*London illustrated news.*)

the latter, of Mongol-Turkish. Of these four tribes, the Dshemshidis are the most important. They were formerly much more numerous than now. To-day they number about six thousand families, of which four thousand dwell at Kushk, a place near the sources of the river of the same name; a thousand at Bala-Murgáb; and a thousand at Kurukh. Most of them lead a half or wholly nomadic life, and have adopted Turkish manners and customs, although favorable political circumstances might easily turn them into peaceful, industrious citizens.

Next to these come the Firuzkuhis, whose territory extends from Bendi-Turkestan on the north, to the sources of the Hari-Rud on the south. They are also of Iranian origin, and fall into two distinct sub-tribes, — the Derzais and the Mahmudis. They comprise, in all, eleven thousand families, and their chief town is Kila Nau ('New Fortress'), which really lies in the territory of the Hazaras. At the present time the tribe of the Derzais dwells in the mountain region, while the Mahmudis occupy the lowland. The Teimenis, fifty thousand families strong, live in the region lying south of the Hari-Rud, and, in spite of their unmistakably Mongolian origin, have become completely settled, and even enjoy the reputation of being excellent cultivators. The fourth member of the Tshehar-Eimaks is the tribe of the Teimuris, who inhabit the western part of the Baghiz district, and are at home at Pul-i-Khatun, Germ-ab, the pass of Zolfikar (a cut of which is here reproduced from the *London illustrated news*), and along the whole eastern boundary of Persia. They number about fifteen thousand families, and form the ethnical element, so to speak, which first brought about the difficulty between the two European rivals.

Taken all in all, the inhabitants of Herat form, indeed, the best possible element for the designs of a foreign conqueror; for they have been accustomed for centuries to foreign rule, and, with slight exceptions, are hostile equally to the Uzbek on the north, the Afghan on the south, and the Persian on the west. Their greatest political ambition, the independence of Herat, has seldom been realized; and if now, when European conquest is extending to this part of central Asia, either the Russians or the English should succeed in becoming estab-

lished here, they would find in the ethnical relations such a basis of power, and accordingly obtain such a firm foothold, that their dislodgement would be no easy task.

We have still to speak of the part which Herat, for the very reason of the advantages referred to above, has played in the past. Herat is to-day, to some extent, the centre of trade between India, Persia, and central Asia, where new goods are exchanged, the packages are overhauled and re-arranged, and the caravans spend some days, or even weeks, in resting for their farther journeys. And so, in antiquity, Herat was the point from which almost all the conquerors of India and western Asia set out. Alexander the Great stopped there in 327 B.C.; the Mongolians under Dshengiz halted there in 1220 A.D., before going on to the Indus; Timur passed through Herat on his march toward India in 1381; Sheibani Khan, the Uzbek prince, was intending, in the beginning of the sixteenth century, to start from Herat to India; and Nadir Shah, in 1731, did not dare to attempt the way toward southern Hindostan until he was in possession of Herat.

History repeats itself everywhere with very similar episodes. What the early Mohammedan and Buddhist adventurers attempted when they crossed the Oxus, and, attracted by the rich treasures of India, went towards the south, is the same thing which the present successors and representatives of the Tartar warriors — viz., the Russians — are aiming at; for they, too, have an eye upon the fields of India, however much czars and ministers disclaim the fact, or Russian scholars talk of the 'noble mission of culture' fulfilled by the attempts of their army in Asia. If Russia had not already spent over four hundred million dollars in carrying out her policy in central Asia, and if this central Asia were not such a useless acquisition, which can never be a source of revenue, but always an expense, we might put some faith in these assertions; but no one is so simple nowadays as to ascribe persecution on the part of individuals or states to purely philanthropic or unselfish motives. Russia wants the 'Gate of India' in order to reach India; and the essential difficulty in her plan consists in the fact that the land on the Ganges and Indus is controlled, not by effeminate Brahmins, or the degenerate successors of Baber, but by the active, highly educated, and powerful Briton, and that any aggressor at present, instead of carrying home the golden gates of the palace of Somnath, as did Mahmud the Ghaznewid, would be much more likely to come off with a broken head.

COPE'S TERTIARY VERTEBRATA.

When this immense work is completed by the issue of the second part, we shall have by far the most extensive and valuable survey yet attempted of the tertiary vertebrates, which have been discovered in our western territories in such amazing profusion. Dr. Leidy's excellent volumes now cover but a small portion of the ground, which has been so greatly extended since they were written. In Professor Cope's new book, which looks as formidable as an unabridged dictionary, one hardly knows whether the vast collections which he has brought together, or the skill with which they have been worked up, is most to be admired; for this book is no mere wearisome compilation of descriptive details, but a notable contribution to morphology and the theory of evolution.

After a general account of the tertiary formations of the central United States, the introduction proceeds to a much-needed discussion of the correspondences between the geological periods of Europe and North America. This has often been attempted before; but the new material lately obtained sheds much light upon these vexed and difficult questions. In the paleozoic formations, these identifications can in many cases be made easily and certainly; but in the mesozoic, and still more in the tertiary, deposits, they become very problematical. A starting-point, however, seems to be given to us in the Wasatch of America, which seems to be the exact equivalent of the French Suessonian: later than that, the correspondences seem to be but general. Professor Cope still maintains his former view, that the Laramie (the great coal-bearing formation of the region west of the Missouri) is of cretaceous age. In this connection, it is interesting to compare with Professor Cope's arguments those advanced by Professor Lesquereux in his work on the cretaceous and tertiary flora, which has just been issued as volume vii. of this same series of reports. Professor Lesquereux attacks the problem chiefly from the botanical side, but, after reviewing all the evidence attainable, pronounces emphatically in favor of the tertiary age of the Laramie. It seems to us that Lesquereux makes out rather the better case, and that possibly the Laramie may prove to be contemporary with the earliest eocene formation of this country, the Puerco; the former being composed of swampy and estuarine deposits, and the latter of lacustrine. This view is much strengthened by the recent discoveries of Laramie dinosaurs in the Puerco, and of marsupials like those of the Puerco in the Laramie. Further evidence must, however, be awaited, before the hypothesis can be accepted.

It is to be regretted that Professor Cope

The Vertebrata of the tertiary formations of the west. By E. D. Cope. Book 1. (Rep. U. S. geol. surv. terr., vol. iii.) Washington, *Government*, 1884. 1,009 p., 135 pl. 4°.

did not add to this section of his introduction a general survey of the animal life in each of the periods which he afterwards treats in detail. Such a summary would have been exceedingly useful.

Before examining the book in detail, it will be of advantage to direct the reader's attention to Dr. Hayden's summary of "the most important contributions to paleontology and evolution," contained in his letter of transmittal of the volume before us. These are: 1°. The discovery of the Puerco fauna. This includes the discovery and description of three new families of a new order (the Taxeopoda), and a new sub-order (the Taligrada); also the discovery of the Plagiaulax type (of the Jurassic), and other marsupials, and of a genus of Laramie saurians. 2°. The discovery of complete remains of the Wasatch types, Phenacodus and Coryphodon. "The light thrown on the phylogeny of the Ungulata by this discovery exceeds that derived from all other sources together." 3°. The new classification of the lower clawed mammals, founded on the analyses of a great number of new genera and species. 4°. The restoration of the four-toed Wasatch horse, Hyracotherium. 5°. The restoration of the Bridger genera, Hyrachyus and Triplopus. 6°. The determination of the systematic relations of the Dinocerata.

Turning, now, to the body of the work, the first chapter to demand notice is that on the fishes. The shales of Green River, Bear River, and Florissant, Col., have long been famous for their abundance of fish-remains. Our knowledge of these forms is almost entirely due to Professor Cope, but hitherto he has figured none of them. In the present volume there is a very welcome series of plates that illustrates all the types. It is a pity that Professor Cope has adopted the classification he uses, which, being founded entirely on the skeleton, and ignoring the structure of the soft parts, is necessarily imperfect and misleading.

Perhaps Professor Cope's most signal service to paleontology is his discovery of the exceedingly curious and interesting Puerco fauna, the earliest known from any tertiary formation. This assemblage of mammals is of extraordinary interest, both to the morphologist and the geologist, and goes a long way towards bridging over the gap between the tertiary and mesozoic ages. The characteristics of this fauna were given above, but we must again insist on the immense value of its discovery.

In the Wasatch, the second epoch of the eocene, we are presented with a no less interesting series of mammals and reptiles. The only full account extant of American tertiary turtles and crocodiles is here given. Further, our knowledge of the Wasatch mammals is almost altogether owing to Professor Cope, whose explorations of the Big Horn basin in Wyoming yielded such extensive collections. The chapters on the ungulates of this formation are of especial importance. The study of these has confirmed the author's prediction, made in 1873, that the earliest ungulates would prove to be five-toed and plantigrade, and has enabled him to construct a scheme of all the ungulate series, which, however we may differ as to its details, must be admitted to be a masterly presentation, and full of most valuable suggestions. These chapters, and especially the descriptions of the skeletons of Periptychus from the Puerco, and the Wasatch genera Phenacodus and Hyracotherium Owen (Orohippus Marsh), of which Professor Cope gives the first complete account, are to be particularly commended to careful study.

A very welcome section of the book is that on the order Amblypoda, which includes the Dinocerata and the Coryphodons. This order, proposed in 1873 by Professor Cope, has recently been adopted under the name of Amblydactyla by Professor Marsh. The latter's work on the Dinocerata is so much fuller and more complete than Professor Cope's chapters on them, that we need not stop to consider the latter, except to mention the curious Bathyopsis. But nearly all that is known of the Coryphodons is due to Professor Cope's labors, and the value of his results in this field it is difficult to exaggerate.

Professor Cope has brought order out of the chaos of the small mammals which abound in the eocene, and which, with great diversity, pass into each other by imperceptible gradations. He groups together the early flesh-eaters — which were not true carnivores, but small-brained forms allied to the insectivores — under the name Creodonta, giving in many cases very complete accounts of their structure, and indicating the forms from which descended the various families of the true carnivores. The same service has been done for the primitive lemurs, the most interesting of which is the little Wasatch Anaptomorphus homunculus, which has as large a brain as, and in some respects a higher type of dentition than, any existing lemur, and which seems to be a progenitor of the monkeys. Did space permit, the curious Taeniodonta would demand notice.

In the Bridger formation, Professor Cope has not achieved such great things as in the earlier periods. Nevertheless, the sections on the reptiles, the rodents, and the tapiroids Hyrachyus and Triplopus, are notable contributions to the subject.

In closing this very brief and inadequate sketch, we must call attention to the beautiful series of miocene carnivores with which part i. ends. Nothing can exceed the perfection of their preservation, and they enable the paleontologist to follow the evolution of the group without difficulty. Professor Cope says with much truth, "No fuller genealogical series exists than that which I have discovered among the extinct cats."

As is unavoidable in the case of a volume nearly five years in course of printing, this book contains much that riper judgment and fuller knowledge have modified. Thus have arisen the occasional contradictions between different parts of the book; and in recent articles in the *American naturalist* the author has expanded and modified many of his conclusions. But, aside from these, some of his results are open to serious question, and with scarcely any of his phylogenetic tables can we fully agree. His tendency seems to be to generalize too hastily from the study of some special structures, as the dentition or the feet, to the exclusion of other important parts. The book has been rather carelessly printed, and shows many typographical errors; and the references to the plates are frequently and annoyingly wrong, compelling the reader to a tedious search. The plates themselves cannot be praised: many of the figures are badly drawn, and in one case, at least, the drawing is ludicrous (woodcut, fig. 25*a*). With few exceptions, the lithographic work is not up to the usual standard of the Sinclairs, and contrasts unfavorably with the exquisite workmanship of Professor Marsh's volumes.

But, in spite of these drawbacks, Professor Cope has done a grand work, which is an ornament to American paleontology, and must ever remain a landmark in the history of the science, as well as "a monument to the labor and genius of its author."

PHILLIPS'S ORE-DEPOSITS.

CONSIDERING the immense importance of the mining industries, it is remarkable that there have been so few treatises on the manner of occurrence and origin of the various ore-deposits.

A treatise on ore-deposits. By J. ARTHUR PHILLIPS, F.R.S. London, *Macmillan & Co.*, 1884.

With two or three noteworthy exceptions in Germany, and one or two in France, the literature on this subject is confined to the vast number of special papers. Whitney's 'Metallic wealth of the United States,' a model work which has been of great usefulness, treated, in its descriptive part, only of our own country. Mr. Prime's translation of von Cotta's 'Erzlagerstaettenlehre' has been for years the only general work on the subject in the English language. Since that was written, our manifold mining industries have assumed an importance that will be best understood when we say that during the year 1880 there were nearly ten thousand mines of all kinds and sizes operating east of the 110th meridian. This does not take into account the mines of the precious and other metals of the west, which must number over three thousand. There is a pressing need of a general work based on a survey of our own rich field.

Pending the appearance of such a work, this book by Mr. Phillips, who has visited many American mines, draws largely, both for facts and theory, from the American experience of its author, and will be found to be very serviceable.

In its general plan and appearance it recalls von Cotta's work. The first hundred pages are devoted to the general classification of deposits. The remaining five hundred or more pages describe in detail the noteworthy and instructive occurrences throughout the world.

The classification adopted is well chosen, and is as simple as is consistent with our knowledge of the subject.

I. Superficial.	*a.* Deposits formed by the mechanical action of water.
	b. Deposits resulting from chemical action.
II. Stratified.	*a.* Deposits constituting the bulk of metalliferous beds formed by precipitation from aqueous solutions.
	b. Beds originally deposited from solution, but subsequently altered by metamorphism.
	c. Ores disseminated through sedimentary beds in which they have been chemically deposited.
III. Unstratified.	*a.* True veins.
	b. Segregated veins.
	c. Gash veins.
	d. Impregnations.
	e. Stock-works.
	f. Fahlbands.
	g. Contact deposits.
	h. Chambers, or pockets.

In the general part, which follows, these different forms are discussed in the light of the latest investigations.

The forming of the siliceous gangue in fissures by lateral secretions is illustrated in the

chalk where the infusorial silica occasionally segregates into cracks instead of into flint nodules.

The breaking-down of the material of the walls of vein-fissures, its alteration, and incorporation, in place, into the gangue, are briefly but well described, and illustrated by drawings made from thin sections under the microscope. Much weight is given to the results of Sandberger's researches, which seem to establish quite firmly lateral secretion as the generally most important method of vein formation and enrichment. Mr. Phillips gives in this connection a very instructive *résumé* of some of Sandberger's results, which show the widespread distribution of both the heavy metals and the elements of the gangue substances in the constituent minerals of the common rocks.

Not less interesting are the instances cited to show the sufficiency of causes acting now and in recent times at the surface of the earth, to cause the concentration and fixation of minerals to form ore-bodies.

Thus the fact shown by Sandberger, that all lithia micas contain tin, taken in connection with the finding, in various Cornish streamworks, of deer's antlers completely replaced by crystallized oxide of tin, points at once to the existence of sufficient sources of tin in surface rocks, and to the possibility of derivation from those sources, and concentration in veins and stock-works, under conditions now prevailing at the surface. So, also, in the instances of metallic gold which have been found deposited on the woodwork of Australian mines, we have similar evidence of metallic deposition now in progress.

While Mr. Phillips considers that the evidence is largely in favor of assigning to lateral secretion the generally most important part in forming fissure-veins, he recognizes the probable action of ascension, and also of sublimation, in many individual cases. The portion of the book — about five hundred pages — devoted to the description of typical forms of deposits throughout the world is full of information desired by the economic geologist and the statistician.

The illustrative instances are well selected, and the latest available statistics of production are given, apparently, in all cases. Aside from the fact that it brings the description of the countries treated by Cotta down to the present time, the book is particularly valuable for its descriptions of practically all countries which, for various reasons, received little or no attention in Von Cotta's work.

THE MICROSCOPE IN BOTANY.

THOSE students who have been waiting for an English translation of Behrens's book on botanical methods can but be disappointed now that it has appeared. Not that the book does not contain much that is extremely valuable, nor that it is not put in an attractive form by the publishers, but that it has been made cumbersome and expensive by an inordinate amount of 'padding' not found in the German text. Figures and descriptions of American instruments are introduced with such careful discrimination, that doubtless the volume must prove eminently satisfactory to their makers, while the author's remarks on the more useful stands of continental make are entirely suppressed, possibly from a laudable wish to further home protection. The maxim of the author, that "he is the best experimenter who does his work with the simplest possible apparatus," is frequently outraged by the description of gimcracks easily dispensed with, and more properly advertised in an instrument-maker's catalogue than in the pages of an expensive handbook.

Yet, notwithstanding the fact that a two-dollar-and-a-half book has been evolved into a five-dollar book by a process the reverse of natural selection, the translation must prove a boon to the few investigators who have not sufficient command of German to use the original; and it is unquestionably more convenient for college students, who, as a rule, dread manuals in any language but their own. Those who use the book in either form will probably agree with the author that the chapters on reagents and their application in microchemical work constitute its most valuable feature, rendering it, indeed, indispensable in the laboratory where careful work is carried on. A chapter on the preparation of specimens for examination and preservation is also extremely useful, and especially the portion treating of the preparation of fossils and other hard objects.

Though a few more or less deserved slurs on English microscopists, and the author's all but complete forgetfulness that Americans ever look through the instrument, may touch the pride or appeal to the belligerence of an Anglo-American, the book is, in the main, written well and in good taste, and shows a working familiarity both with the subjects handled and the literature pertaining to them.

A guide to the microscopical investigation of vegetable substances. From the German of Dr. JULIUS WILHELM BEHRENS. Translated and edited by Rev. A. B. Hervey, A.M., assisted by R. H. Ward, M.D., F.R.M.S. Boston, *Cassino*, 1885.

SOME STATE AGRICULTURAL EXPERIMENT-STATIONS.

A COMPARISON of the successive reports of the New-Jersey experiment-station shows that it has rapidly passed beyond that initial stage of nearly every American station, in which its chief duty is the 'control' of the trade in commercial fertilizers. It is still a fertilizer control station, and, as its report shows, has been active in this field; some two hundred analyses being reported, and much thought having evidently been bestowed upon the various problems arising in connection with the equitable sampling and valuation of these goods.

At the same time, this work occupies but fifty-four pages out of a total of a hundred and seventy-six, the larger portion of the remainder being taken up with reports of experiments bearing upon the broader questions of agricultural practice.

These latter furnish an admirable illustration of the class of experiments which, in a previous number of *Science*, we ventured to designate as empirical, as distinguished from rational — using these words, of course, in their technical sense. They are what are often called practical, as opposed to scientific experiments; but the word 'practical' has been so wrested, in popular use, from its proper meaning of 'pertaining to practice,' that its use in this connection is to be avoided.

Besides various minor matters, the most noteworthy experiments of this sort are the field experiments upon the growth of sorghum, and the comparison between field-corn and ensilaged fodder-corn.

In the last-named investigation, the questions proposed were, the comparative yield of digestible food per acre, the comparative cost of gathering it and preparing it for use, its relative feeding-value, and the relative exhaustion of the soil in the two cases. The results were throughout decidedly in favor of the field-corn; the grain and stalks yielding more and cheaper food per acre than the ensilaged fodder-corn, and food of equal milk-producing value, pound for pound.

The report of the Ohio station, while dealing with different subjects, resembles that of the New-Jersey station in the general character of the experiments reported. A great deal of attention has been given to testing varieties of wheat and corn, and the tables of results contain a vast amount of valuable information. The tests of methods of seeding or planting, of cultivation, mulching, use of fertilizers, etc., are extensive, and apparently carefully conducted, though we regret to observe the somewhat common lack of an adequate discussion of the results reached. Other interesting matter is to be found in the sections devoted to small-fruits and vegetables, insects, weeds, grasses, and various other subjects.

In brief, both these stations have done most excellent work of the kind attempted; and that this kind of work meets with popular approval, is evident in New Jersey, at least, from the fact that the station's original appropriation of five thousand dollars per year has been successively raised to eight thousand and eleven thousand dollars. Under the circumstances, it is not to be wondered at that the station has turned its attention chiefly or entirely to experiments relating to the practice of agriculture. At the same time, we cannot but regret that the American stations, as a rule, many of them with reasonably ample incomes, are doing so little, comparatively, to advance the science of agriculture, believing, as we do, that 'a sound theory is the surest guide to a successful practice.'

Fifth annual report of the New-Jersey state agricultural experiment-station for the year 1884. Princeton, N.J., *Robinson pr.* 1884. 176 p. 8°.

Third annual report of the Ohio agricultural experiment-station for 1884. Printed by order of the state legislature. Columbus, *Myers brothers, state printers*, 1885. 240 p. 8°.

NOTES AND NEWS.

A STATUE of Darwin, by Mr. Boehm, R.A., has just been placed in the great hall of the British museum on Cromwell Row, and arrangements for its unveiling will be made shortly. It is the gift to the nation of the Darwin memorial fund. It is found, that, after the payment of all expenses, over two thousand pounds will remain, which will form a Darwin fund, to be transferred to the Royal society, the income of which is to be appropriated in such a way as may be "best calculated to promote biological study and research."

— The Society for the prevention of cruelty to animals in the Netherlands has petitioned the government to introduce into Holland the rules with regard to vivisection drawn up by the Prussian authorities.

— In the Spanish congress on May 18, according to *Nature*, Señor Castelar called attention to Dr. Ferran's experiments in inoculation against cholera, and asked the minister of the interior to give a subvention to enable Dr. Ferran to continue his experiments on a larger scale. The minister, in reply, said he was unable to do so at present, but, as soon as it lay in his power, he would grant a sufficient sum, although, in his opinion, Dr. Ferran's experiments had not yet reached a sufficient degree of certainty to prove a complete success. He added, that a commission of medical men would be appointed to visit Valencia

and other towns, in order to study the experiments that are being made. In reference to this subject, Dr. Cameron, M.P., writes to the *Standard* that the under-secretary for foreign affairs has promised to instruct the British minister at Madrid to send home translations of any reports bearing on the system of inoculation with cholera virus attenuated by artificial cultivation, as a protection against Asiatic cholera, discovered by Dr. Ferran of Valencia. This having come to the notice of Dr. Ferran, that gentleman has sent Dr. Cameron a telegram giving the results up to date of a great test experiment which is at present being conducted by him, under the eyes of scientific commissioners at Alcira, a town near Valencia, where an epidemic of cholera is raging. According to Dr. Ferran's telegram, the population of Alcira is 16,000, and since the first of the present month 5,432 of its inhabitants have been inoculated with his protective virus. That would leave the number of those not inoculated about 10,500, or, accepting 16,000 as an exact figure, precisely 10,568. Of the 10,500 persons who are not inoculated, cholera has attacked 64, and proved fatal to 30. Of the 5,432 who have been inoculated, it has, according to Dr. Ferran, attacked only 7, and proved fatal in no single case. In other words, since the commencement of the experiment on May 1, one person out of every 163 has been attacked among the uninoculated population, and one person in every 352 has died of cholera; while among the inoculated population only one person in 776 has been attacked, and not a single person in the entire 5,432 has died of the disease. Dr. Ferran concludes his telegram by expressing the desire that a British commission should be sent to Alcira to verify these results.

— The first edition of Johne's little book upon the cholera bacillus ("Ueber die Koch'schen reinculturen und die cholera bacillen," Leipzig, *Vogel*) was published in January, and a second is already out. It is a pamphlet of some twenty-eight pages, giving the most complete directions for cultivating and observing the so-called comma bacillus according to Koch's method, from the preparation of the 'meat extract gelatine' to the microscopic examination. A woodcut showing the different rapidities of liquefaction of the gelatine culture-medicine by the comma bacillus of cholera, and the curved bacillus of Finkler and Prior, is given, and adds to the value of the work. It is an important contribution to the literature of bacteriology, furnishing, as it does, our first concise and complete statement of the methods of investigation of the special organism of which it treats.

— Capt. Sawyer of the bark Vidette reports that on May 17, 1885, a water-spout appeared to form, and rise to the north-east in a long, spiral column; position at the time, latitude 32° 10′ north, longitude 78° 5′ west. It rose until the sky above, extending over an area of a mile, was an inky black mass of heavy clouds, gradually moving in a south-west direction until within half a mile of the vessel, when it seemed to burst, the rain coming down in torrents for two hours. This was accompanied by sudden strong gusts of wind, shifting suddenly from one quarter to directly the opposite one, and with a force of six to eight. To the south and south-west before and during the formation of the water-spout, the sky, to an altitude of about sixty degrees, was black and very threatening, with thunder and lightning. This continued during the time alluded to, and finally ended with several sharp claps of thunder and a fifteen-minutes' fall of hailstones. The peculiarity of these disturbances was that the wind would change very suddenly with considerable force, throwing all aback without any warning. The temperature of the water was 81°, and of the air 60° to 78°.

— The time-ball of the U. S. naval observatory is to be transferred from the dome of the observatory to a flagstaff on the new State, war, and navy department at Washington. In its new position it will be more easily seen from the city. It will be dropped, as at present, by the observatory clock, on 75th meridian time.

— Among recent deaths we note the following: Dr. A. Enneper, professor of mathematics in the University of Göttingen, at Hannover, March 24, in his fifty-fifth year; Eugène Rolland, professor of mechanics, at Paris, March 31; J. C. Döll, botanist, at Karlsruhe, March 10, in his seventy-eighth year; Gustave A. von Klöden, geographer, at Berlin, March 11, in his seventy-first year; Dr. Wilhelm Duncker, geologist, at Marburg, March 13, in his seventy-seventh year; Dr. J Roeper, botanist, at Rostock, March 17, in his eighty-fifth year.

— Capt. George E. Belknap, U.S.N., has been ordered by the secretary of the navy to assume charge of the naval observatory on June 1, relieving Commander A. D. Brown, who has been acting superintendent since April 1, when Admiral Franklin was ordered to the command of the European squadron.

— The Harvard university bulletin for May contains nine pages more of Mr. Winsor's collation of the Kohl collection of early maps, which in this case deals with the east coast of North America, and four pages of Mr. Bliss's index to the maps in the English geographical publications, comprising a part of those of Asia.

— The third session of the International geological congress will be held this year at Berlin, commencing on the 28th of September. The meetings will occupy one week, and will be followed by geological excursions from the 5th to the 10th of October. The congress will be accompanied by an exhibition of geological charts and other collections illustrating the different branches of mineralogy and geological science. It will be remembered that this meeting was to have taken place last year, but was prevented by the outbreak of cholera.

— A memorial tablet to Professor Louis Agassiz has just been erected in the Sage Chapel of Cornell university, and will be unveiled at the approaching commencement.

— A National textile microscopical association was formed last Saturday by members of the corresponding societies of Boston and New York.

SCIENCE.

FRIDAY, JUNE 12, 1885.

COMMENT AND CRITICISM.

Lieut. Cornwell, who is to carry on the series of latitude observations at the U.S. naval observatory, referred to in a previous number of *Science* (vol. v. p. 60), has recently returned from an interview with Professor Oom, the director of the observatory at Lisbon. A list of eleven stars has been selected, and the details of the work have been agreed upon. But two stars will be observed in a night, each star being observed east and west of the meridian before the succeeding star is taken up. Some fifteen or twenty observations of each star will be made during the year. With the exception of α Lyrae, the stars range from the fourth to the sixth magnitude, and the greatest zenith distance at which any star will be observed at Washington is not greater than twelve or thirteen degrees. It is proposed to erect an azimuth mark for testing the stability of the instrument; and a careful determination of the level will, of course, be made with every observation.

This question of the variability of latitudes is one of considerable interest. Theoretically, periodical changes of latitude may occur, and an examination of observations made at a number of northern observatories during the past seventy-five years — Königsberg, Milan, Naples, Paris, Pulkowa, and Washington — appears to confirm the existence of such changes. At Pulkowa, which furnishes the most careful series of observations, a diminution of the latitude of 0.23″, equivalent to about twenty-three feet, is indicated between the years 1843 and 1872; but in all these cases the variations are small, and we must be extremely cautious in ascribing them to actual changes of latitude. A series of observations made at Willet's Point by young engineer officers, under the direction of Gen. Abbot, also appears to have some interest and possible bearing on the question. By these observations a diminution of ninety-five feet is shown in the latitude since 1880; but here, again, it is quite possible that this apparent change may be due to errors of observation. Fergola's plan of making a careful series of observations at pairs of observatories, in about the same latitude, but differing considerably in longitude, will, if thoroughly carried out now, go far towards enabling us to give a definite answer to the question fifty years or more hence.

The *American engineer* of May 8 contains an article on the levee system of river improvement which demands notice from all who wish the line between fact and fiction to be sharply drawn. The case presented is briefly this: the Mississippi-River commission, in 1883, asserted that they had restored the levees along the Yazoo front so as to exclude overflow from the head of that basin, and that as a consequence the height of flood at Vicksburg was about five feet lower in 1883 than it had been in 1882; and upon this assertion of facts the commission based an argument for the general construction of levees along the Mississippi as a means of channel improvement. The flood of 1884 came, and rose three inches higher at Vicksburg than it did in 1882, thereby completely overthrowing all the argument of the commission.

In the article referred to, 'J. B. J.' quotes from later reports of the commission proof that the commission had not restored the levees along the front in question in 1883, nor had it been done in 1884. Unless the clearly implied charge that this misstatement was wilful is successfully met by the members of the commission who signed the report of 1883 (General Comstock did not), it would seem that the

president of the United States ought to make inquiry, and relieve the country of the discredit which must come from the challenged veracity of an official body whose acts and sayings are being closely followed abroad and at home.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Professor Hastings's theory of the corona.

I SHOULD be glad, with your permission, to make a few remarks with reference to a passage in Professor Hastings's letter in your issue of April 24. Professor Hastings states that he shows, in his report of the eclipse expedition to Caroline Island, that all the characteristics of the corona may be explained naturally and easily by his diffraction theory, *with the exception of the occasional filamentous structure.* The words which I have italicized convince me that Professor Hastings cannot have paid sufficient attention to the abundant and irrefragable evidence as to the solar corona which is afforded by photographs taken during total solar eclipses. These photographs prove that what Professor Hastings summarily characterizes as 'occasional filamentous structure,' constitutes the greater portion of the corona. In the photographs of the eclipse of 1871, there were more than a hundred distinct details of this kind, which I measured and drew, when assisting Mr. Ranyard in describing and cataloguing the details of the structure of the corona (*Mem. roy. astron. soc.*, xli. 657-686). These details were, of course, not all visible on a cursory inspection of the negatives; many of them were not perceived till after long study: but, once seen, there was no mistake as to their existence, and none were described that were not visible on at least three of the plates.

Moreover, since the coronal rays are very various in direction, and are seen in the negatives one behind the other, and at all angles of projection, it is evident that the corona must in reality be far more 'filamentous' than it appears in the photographs. To a greater or less extent, the same character is shown in negatives of other eclipses, though somewhat less of it is visible in some of the more recent photographs, probably on account of the greater density of the film in the case of those taken on the extremely sensitive dry plates.

I cannot enter into the optical points connected with Professor Hastings's theory, but simply wish to point out, that, if it will account for every thing except the 'filamentous structure,' it accounts, after all, for very little. W. H. WESLEY.

Royal astron. society,
Burlington House, London.

The natural gas-wells of north-western Ohio.

The gas-wells that have been drilled within the last year in Hancock and Wood counties, O., have furnished some interesting, and to some degree unexpected, information as to the geological foundations of the state. They show the presence of several formations that nowhere appear in outcrop within the limits of Ohio. The section furnished by them agrees quite closely, as to its elements and its general lithology, with the New-York scale.

I have lately examined the carefully kept records and drillings of six of these wells. They agree entirely in their main features. All begin in upper Silurian limestone, and all find their main supply of gas in the Trenton limestone. The section furnished by them is as follows:—

	Feet.
Niagara limestone, gray and blue, dolomitic	200
Niagara clay, a characteristic bed in central Ohio	2–4
Clinton limestone and shale, high colored	75
Medina shale, red and blue	50–100
Hudson River shale, gray and blue	400–500
Utica shale, dark, almost black, in places	275
Trenton limestone	300
Bird's-eye limestone	?

The Trenton limestone was drilled through in but a single well.

The Niagara clay contains characteristic fossils, as does also the Hudson-River shale and the Utica shale. The former shows chaetetoid corals, and fragments of Zygospira and Orthis. The Utica shale contains Leptololus insignis Hall, and fragments of the spines of Echinognathus of Walcott apparently. The Trenton limestone is crystalline and hard, but it shows the presence of fossils in abundance.

The gas obtained from the wells is delivered with moderate pressure. It contains a notable quantity of sulphuretted hydrogen. It is used so far mainly for heating and for steam-production. Judicious estimates put the amount yielded each day by three wells in Findlay, the county-seat of Hancock county, at five hundred thousand feet. EDWARD ORTON.

Columbus, O., June 1.

A tropical American turtle on Anticosti.

Professor John Macoun, botanist to the Canadian geological and natural-history survey, has shown me a turtle which was given him by the light-keeper at West Point, Anticosti, in August, 1883. It was found living near the lighthouse, and was the only one seen by the keeper during his twenty years' residence on the island. Mr. F. W. True, to whom I sent the specimen for identification, pronounces it to be a half-grown Chelanoides tabulata (Walbaum) Agassiz. The habitat of the species is tropical South America and the West Indies, whence it was probably brought to Anticosti on some vessel. C. HART MERRIAM.

Abert's squirrel.

On the 10th of April last, on my return from a five-days' visit to the pueblo of the Zuñis in New Mexico, I drove through an extensive pine-forest, which the road enters a few miles from Fort Wingate, my destination.

There were in the ambulance with me, besides the driver, Prof. J. W. P. Jenks of Brown university, curator of its museum, and a fellow-traveller, a friend from Philadelphia. Professor Jenks was eagerly on the lookout for rare things in south-western birds and mammals for his college museum, while his friend was enjoying himself in examining two specimens we had taken along the road, and joining in the conversation as best a layman may, when two enthusiastic naturalists formed the odds against him.

Suddenly the driver stopped the conveyance, and directed my attention to a large gray squirrel that had just scampered up the trunk of one of the lofty pines, and was now sitting, partly hiding, on the lower limb, close to the body of the tree.

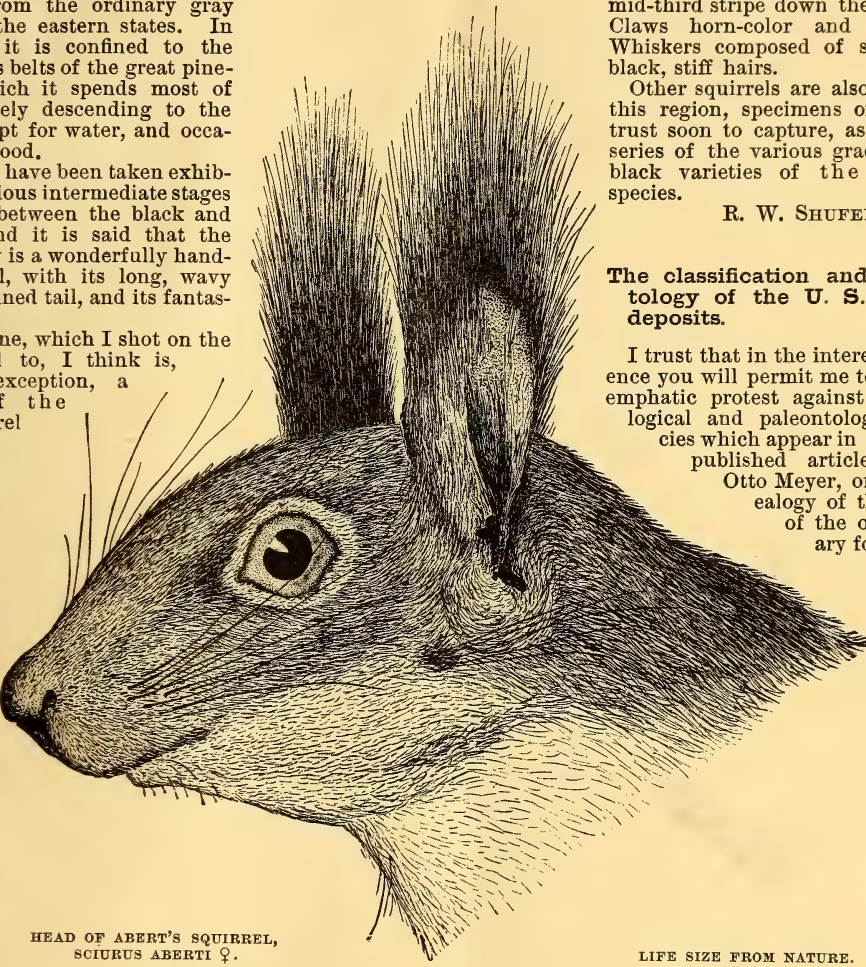
In a moment this magnificent creature was mine, dead at my feet.

It proved to be a fine female specimen of Abert's squirrel in the gray pelage; and I subsequently learned from others who have hunted them in this locality, where they are by no means abundant, that they are sometimes taken where their fur is of a jetty black, with the tail broadly bordered with snowy white, and perhaps similarly marked on the breast and lower parts.

Old hunters who have had the opportunity of observing its habits, say that it differs but little from the ordinary gray squirrel of the eastern states. In this region it is confined to the mountainous belts of the great pine-trees, in which it spends most of its time, rarely descending to the ground except for water, and occasionally for food.

Specimens have been taken exhibiting the various intermediate stages of coloring between the black and the gray; and it is said that the black variety is a wonderfully handsome animal, with its long, wavy white emargined tail, and its fantastic ear-tufts.

The gray one, which I shot on the day referred to, I think is, without exception, a specimen of the finest squirrel in the fauna of our country. I have no acquaintance with another American species that can compare with it. I do not remember having seen at any time a drawing of this squirrel: so, after having carefully prepared the skin and skeleton of my specimen, I made the life-size figure of its head which illustrates this letter.



HEAD OF ABERT'S SQUIRREL, SCIURUS ABERTI ♀. LIFE SIZE FROM NATURE.

From it I also took the following measurements, and description of its external characters and appearance: —

	Centimetres.
Length of body from tip of nose to root of tail, down the back	35.0
Length of tail	34.0
Height of ear, including tuft	6.5
Fore-paw, from inner pad to longest claw	4.3
Hind-paw, from inner pad to longest claw	4.8
Tip of nose to anterior canthus of eye	3.2

Entire upper parts of a grizzly, iron gray. Lower halves of inner aspects of ear-tufts, and a median broad stripe from shoulders to near root of tail, of a brilliant chestnut. Ear-tufts large, composed of straight black hairs. Entire under parts, borders of tail, circum-ocular stripe, and upper sides of feet, pure white. A rather broad dividing-line at either side, between the white of under parts and gray above, jetty black. Central hairs of tail, for its entire length, also black, forming a mid-third stripe down the member. Claws horn-color and curved. Whiskers composed of six or ten black, stiff hairs.

Other squirrels are also found in this region, specimens of which I trust soon to capture, as well as a series of the various grades of the black varieties of the present species.

R. W. SHUFELDT, M.D.

The classification and paleontology of the U. S. tertiary deposits.

I trust that in the interests of science you will permit me to lodge an emphatic protest against the geological and paleontological fancies which appear in a recently published article by Dr. Otto Meyer, on the genealogy of the species of the older tertiary formations.

The article displays such a monstrous disregard or ignorance (or both) of the literature of the subject of which it treats, and so fully betrays the author's misconception of the numerous species that have been described from the region in question, that it would not even call for a protest, were it not for the air of respectability which is given to it by the cover of the *American journal of science.*

Little can and need be said in response to a thesis which maintains that there is not sufficient evidence to prove that the Vicksburg beds overlie the Claiborne sands, and that, as a matter of fact, the latter will be found overlying the former, when not a particle of evidence is brought forward in support of this statement.

I take this opportunity, also, of warning paleontologists against the acceptance of the numerous new species, which, without either description or proper comparison, are claimed by Dr. Meyer.

ANGELO HEILPRIN.

Academy of natural sciences,
Philadelphia, June 3.

Premature appearance of the periodical cicada.

On the morning of Oct. 12, 1884, when I chanced to be in Virginia, near Clifton station on the Midland railroad, my attention was attracted by hearing at some distance the characteristic, and to me perfectly familiar, note of the periodical cicada (C. septendecim). Regarding this as a somewhat novel occurrence at that time, I decided to investigate it, and at once proceeded in the direction from which the sound emanated. Though the notes were, as usual, interrupted by short intervals, I found it easy to correct my direction with each recurrence of the sound, and was soon at the foot of some small oaks in which the insects were located. There were at least three males, and the interval between the notes was quite short. I stationed myself under one of the trees, and carefully located the spot from which the sound of one of the insects proceeded. Although it was not possible, from any position I could assume, to see the insect itself, hidden as it was in the dense foliage, and at the height of some twenty feet, yet I soon knew within a few square feet the precise part of the tree occupied by it. I remained some fifteen minutes listening to the peculiar murr-r-r-r-row with which I had been deeply impressed when a boy (1854 or 1855) in my native state (Illinois) at the time of the great swarm that left its withering blight on all the vegetation, but which I have since heard for days together as late as 1878. I think all who are really familiar with this sound will agree with me that it has no counterpart in the whole range of sound-producing creatures. The body of the note lasts, on an average, about two seconds, upon a uniform key, when, without being interrupted, the pitch rapidly drops, with what musicians call a 'slur,' for, as near as I can judge, a full octave or more, and the note abruptly terminates. This peculiar termination is difficult to detect where the trees are full of the singing insects, but it is always present; and in this case it was clearly marked, affording me a fine opportunity for studying the phases of the note, and timing its length. Had I been an entomologist, and aware how anomalous this occurrence was, I should doubtless have persisted until I had secured a specimen, and should have searched for exuviae, etc.; but as I felt absolutely certain as to what I heard, and did not know but that it might be a somewhat ordinary occurrence, I merely made a note of the facts, and leisurely left the spot.

Several days afterwards, happening to be in conversation with Prof. C. V. Riley, I casually mentioned the circumstance as a fact in his line, fully expecting him to reply that it was no very unusual thing. To my great surprise, he pronounced it impossible, and wholly discredited the accuracy of my observation. He said I must have heard some other species of cicada; and, when I asked him what other species had a note precisely like that of the periodical one, he could do no better than to name the common harvest-fly (Cicada pruinosa), the sharp, shrill note of which was also perfectly familiar to me, and so different that I could no more confound it with the other than I could the chirp of a sparrow with the cooing of a dove. My attempts to convince him by describing the sound were as ineffective as though I had been speaking to one who was himself unfamiliar with it.

Having the courage of my convictions, I made bold, on the first opportunity, to lay the subject before a Washington scientific body in the form of a verbal statement of the case, whereupon the learned professor surprised me, not only by no longer positively gainsaying it, but by propounding a theory according to which he admitted the possibility of my observation having been correct. His theory was, that, owing to the exceptional heat of the latter part of that season, a few of the brood of 1885 which were nearest the surface might have been prematurely brought out the autumn before. This seemed very reasonable to me, and I promptly (and seriously) congratulated Professor Riley on having discovered a theory to explain my fact.

Here I supposed the matter was to rest; and here it did rest until a few days ago, when to my further surprise, at the close of an exceedingly interesting paper which Professor Riley read before the same society, on the brood of cicadas which has just appeared, he took occasion to bring up the subject of my Virginia observation, and to pronounce it utterly worthless, and the occurrence impossible as contrary to all the canons of entomology. On being reminded of his own theory, above stated, which he seemed to have forgotten, he could not disclaim it, and virtually renewed it, leaving himself in the position of both denying and admitting the possibility of the event.

I do not make these statements with a view to arousing a controversy, but solely in the hope that some of your many observant readers may be able to confirm and perfect the confessedly incomplete record which I hereby make of this singular incident.

I will, however, venture a suggestion drawn from a field with which I am better acquainted. The theory of Professor Riley might, I think, be greatly strengthened by facts derived from plants. The effect of a protracted warm spell in autumn upon the vegetation of this climate has been the subject of investigation on my part for a series of years; and the autumnal flowering of strictly vernal species is a fact attested by a score or more of species, most of which have been recorded and published. It is not contrary to the canons of botany, but consonant to a rational understanding of causes and effects. And why should not similar causes produce similar effects on insects? For one, I cannot doubt that they do so; and I am as firmly convinced now, as I was at the time, that the sound I heard proceeded from veritable seventeen-year locusts that were thus prematurely brought from their long subterranean dungeons into the genial sunlight of that warm October day.

LESTER F. WARD.

Washington, June 6.

The recent Chicago storm and the sun-glow.

The telegraph reports a very violent thunder-storm at Chicago during the night of June 2; the lightning striking many buildings, and causing the loss of five lives. I was in Chicago during a part of Monday, June 1. At that time the reddish glow around the sun which I have recently described in your columns, was almost as intense as I have ever seen it even in Colorado. In Colorado any great increase in the depth of tint of the circumsolar glow portends a fall in temperature with conditions favorable for cold electrical storms. The rule would seem to be about the same at Chicago, though the Great Lakes may tend to prevent the formation of hail near them.

G. H. STONE.

Portland, Me.

VEGETABLE MORPHOLOGY A CENTURY AGO. — LINNÉ AND WOLFF.

"Um die geschichte der wissenschaften aufzuklären, um den gang derselben genau kennen zu lernen, pflegt man sich sorgfältig nach ihren ersten anfängen zu erkundigen." — GOETHE.

In order to clear up the history of the sciences, and to learn to know with exactness the progress of the same, we are wont to give careful attention to their earliest beginnings.

To students of natural science no term is more familiar than 'morphology,' and no doctrine more commonly accepted and understood. Pre-eminently reasonable and natural, the morphology of plants in particular appeals to the simplest understanding. Every schoolboy who has prepared his perfunctory herbarium, or accomplished his stint in plant-analysis, knows something of the meaning of a flower, can tell something of its natural history, — how that bract and sepal and petal, stamen and carpel, are but so many modifications of an ideal leaf, so many varied expressions of a single thought. Likewise the facts to be cited in proof of such assertions are familiar to every-day experience. Who has not gathered pond-lilies, and noted how, by the steps of imperceptible transition, Nature passes on from green sepal to perfected anther? 'Double' flowers of all sorts grow in country gardens, and in springtime the woodland offers anemones which are both 'double' and green. Even prolification is widely known in fact, if not in name.

To all these morphological facts, strange and curious as they certainly are, no one ever attempts to apply any other than the accepted explanation: no other is conceivable, none other is needed. And yet much of the ease with which such explanations are received must be considered due to the habits of thought now prevalent in the world, to the very atmosphere in which to-day men are called to think, to judge. In all the world of thought, ideas of transition are so rife, that unity or community of origin, even of objects most dissimilar, excites small surprise: it is the natural supposition. A different atmosphere, different habits of thought among men, would change completely the simplicity of many a modern page. It is, then, not surprising that a century ago morphology, as we know it, had not so much as found a name; that, with the same facts before them, the best minds in Europe were struggling to the perception of this simple theory, which the schoolboy may now appreciate and understand. The first perception of natural truth, like the opening-up of unknown lands, is a discovery, dim enough when seen in prospect, however easy when once accomplished. Linked with the botanical discovery here to be considered are three most brilliant names, two the brightest of their century, — Linné, Wolff, Goethe; not that all contributed equally to the establishment of the truth, but that to each the problem came, and for it each found answer. What answer to the floral problem each of these great men could give, it is our purpose here briefly to set forth, considering first the labors of Linné and Wolff, later those of Goethe.

Linné, the first in order of time, may be said to have discovered the problem. Passing his life in the study of flowers, the question 'What is a flower?' must have come to the great botanist again and again, pressing him by its very omnipresence almost to his annoyance. But to Linné, fortune-favored, the whole natural world lay like an undiscovered country, — a world too wide for the comprehension of any one mind, however active or versatile. It has been the marvel of all men since his time, that Linné did so much, that his instincts were so true, that to so many questions he gave answers which are the end of controversy. But as regards the morphological problem, the great naturalist seems never to have arrived at a definite conviction. Every thing he says on the subject is more or less obscure. Here, for once, he seems to have reasoned *a priori*, and fancy strangely supplements and distorts the facts discussed. The coincidence of number afforded by the successive layers in the make-up of the stem and the successive circles of organs in the composition of the flower struck him as affording a plausible explanation of the origin of the latter structure. Here are four layers, — the outer bark, the inner bark, the wood, and the pith. The outer bark is often on growing stems green, passing to all appearances imperceptibly into the green covering of the calyx; from the inner bark, white and delicate, come the delicate petals of the corolla; while from the cellular xylem and pith of the stem arise the circles of stamens and carpels respectively; and in the young flower-bud are not the organs last named simply masses of cellular tissue hardly to be distinguished from forming wood and pith? A more careful anatomy would have revealed the mistake; for, as Goethe points out in this connection, "it is the inner bark alone which possesses all power of life and growth;" the other parts of the stem having in the main taken on definite character, and been relegated to inactivity. If we may regard the 'pith' at the end of the growing axis as primary *meristem*, then so far so good; and the fancied relationship is not without its grain of truth.

But Linné did better than this toward the solution of our problem. In his 'Philosophia botanica' of 1751, he, among other things, makes the following propositions: —

"Principium florum et foliorum idem est,"
"Principium gemmarum et foliorum idem est,"

which, so far as it goes, would seem a clear statement of the truth; but it is doubtful whether the author, as he wrote, appreciated the full import of his words. Certainly his immediate followers and pupils did not. He stood face to face with the truth, but recognized it not, and turned away from it, and from the only line of thought which could possibly lead to light, only henceforth to wander in vain speculations and obscurities pertaining to his theory of prolepsis, — a theory understood neither by his contemporaries, his successors, nor possibly even by himself.

But while Linné was thus hopelessly lost in the mazes of his own imaginings, another mind, working in an entirely different field, took cognizance of the problem. A young student, afterwards known to fame as Caspar F. Wolff, away in central Germany in Frederick's university of Halle, had caught the spirit of genuine scientific research, and in his thesis for graduation in 1759 published an exact, succinct, and perfectly clear statement of the modern doctrine of vegetable morphology. Wolff had ideas of his own concerning generation in all the organic world, more particularly in the world of animal life. His taste lay in the line of anatomy in its ordinary scope; and the reference in his thesis to matters botanical was entirely apart from the chief purpose of his dissertation, simply incidental for the sake of completeness; and perhaps, with the propositions of Linné, above cited, before him, he had no thought of propounding any thing new to botanical science. In perfect harmony with his subject, Wolff undertook to elucidate the origin of the various organs of a plant, and in so doing was struck with the extraordinary similarity everywhere patent. Regarding the involucre of the 'compound' flower as calyx, he perceived easily the intergradation of foliage and sepals; the ripened capsule, with bursting sides, afforded evidence of the foliar nature of the carpels; that the seed is largely made up of leaves, appears when it germinates, and the cotyledons assume and perform, to some extent at least, the leaf's function; sepals and petals are often interconvertible, and stamens not infrequently show transition to petals: consequently in the entire plant, so far as immediate analysis goes, we find nothing but root, stem, and leaves.

As Wolff's thesis had to do with generation, and not at all with botany, it is a matter of no surprise that he regarded all this simply as introduction, and went on with his 'theoria generationis,' alleging that the formation of flower and fruit is due to failing energy in the plant; that all modifications have origin in the gradual withdrawal of vegetative power, which diminishes in amount as growth continues, and finally vanishes altogether. What Wolff hoped might be science, has been forgotten; what he lightly esteemed, is science, — fact not without significance, and certainly not without parallel in the history of intellectual work.

But if Wolff did not appreciate what he had accomplished, neither did any of his contemporaries. The seed fell not into good ground. The great Haller was yet living and working, at once botanist, anatomist, and poet; but he saw not the truth, although certainly familiar with Wolff's writings. The Jussieus were busy in Paris, arranging and re-arranging in the Jardin des plantes; but they heard nothing of Wolff: the time was not yet. The scientific vision of the age, dazzled by a sudden discovery of Nature's richness and variety, was not yet ready to be concentrated upon any single problem, however interesting that problem might be in statement, or far-reaching in outcome and solution. T. H. MCBRIDE.

VELOCITY AND SEDIMENT.

THE observations on velocity and sediment on the Mississippi River, from Cairo to the head of the Passes (1,060 miles), have not confirmed the conclusion of Mr. Login, in 'The benefits of irrigation in India,' regarding the relation between these two functions of flowing water. His conclusion is thus stated: "The author believes that the power of water to hold matter in suspension is directly as the velocity, and inversely as the depth. It is also suggested that water in motion rolls rather than slides, and that it is owing to this rotary motion that water has the power to hold matter in suspension; further, that, with given velocities and defined depths, only a certain quantity of matter can be held in suspension, whatever may be the character of the bed or bank of the river or canal. If the velocity be increased, and the depth remain constant, scour will take place. If the velocity be decreased, and the depth is the same, there will be deposit."

The suggestion 'that water in motion rolls rather than slides,' is valuable as explaining the 'inner movements of the particles of water among themselves,' which are aggregated in the indirect currents found even in carefully prepared beds, which are symmetrical, smooth, and straight. These movements were well illustrated by Mr. Francis, in a series of experiments at Lowell in 1867, by mixing whitewash with the clear water of an artificial channel. But the movements of mass inaugurated by the relative movements of the particles of water among themselves appear too feeble to account for the immense quantities of sediment observed in suspension in great alluvial rivers. It also seems clear, as concluded by Mr. Herschel, in his paper on the erosive and abrading power of water, "that direct friction tends to drag materials along the bed, or down the banks, if these have a sufficiently steep side-slope," and that "the effect of the simple friction of a stream upon its bed and banks is not a source of danger: its action is very slow, and it has never been shown to be of a dangerous character in any instance." Certainly the sedimentary grains have no power of motion independent of the water surrounding them; and friction against a smooth bed could not impart such vertical movement to the water as is necessary to lift these grains, except in the slight degree that may result from the movement of the particles of water among themselves. The conditions that prevail in natural stream-beds are necessary for a great suspension of sediment. The projections, inequalities, and sinuosity of such beds expose the material composing them to the impact of the current rather than to simple friction, and also cause those extreme indirect movements of large masses of water that, in great rivers, develop whirls, boils, and eddies, and which alone are capable of lifting numerous and coarse grains of silt, sand, and even gravel. When a 'boil' rises in the Mississippi River, the surface may be raised many inches, and the charge of sediment so dense, that it is seen to roll away from the crater in cloud-shaped masses.

The suspension of sediment is, then, only an indirect result of the velocity, depending more directly upon the character of the bed — its symmetry, smoothness, and straightness, — than upon the velocity, or the relative depth of its different reaches and stages.

The amount of sediment suspended throughout the Mississippi River appears, however, more controlled by the tributary most largely supplying its volume at the time than upon any or all other causes. It was noticed by Capt. Brown, U. S. corps of engineers, that "the Missouri was one of the greatest contributors of sand to the Mississippi River," observably even in the South Pass, 1,300 miles below its mouth.

The apparent anomalies in the following table are largely explained by the relative discharge of the Missouri and the clear-water tributaries. It will be observed that frequently the aggregate bulk or weight of sediment passing per second (2 × sediment in each foot) is greater at or below a mean stage than it is at the maximum.

In this table the velocity is divided into half-feet per second; and in the other columns are given the number of periods during the series of observation in which each rate prevailed, the number of separate measurements taken in each period, and the mean quantity in each period at each rate of velocity.

Fulton, Nov. 27, 1879, to Oct. 12, 1880, Mississippi River commission.

Velocity, feet per second.	Periods at each rate.	No. of observations.	Mean mgr. of sediment in 500 c.c.	Velocity, feet per second.	Periods at each rate.	No. of observations.	Mean mgr. of sediment in 500 c.c.
2.0 @ 2.5	1st	11	339	5.5 @ 6.0	1st	1	235
	2d	14	361		2d	1	530
2.5 @ 3.0	1st	9	511		3d	8	536
	2d	4	311		4th	1	355
	3d	5	434		5th	2	915
3.0 @ 3.5	1st	4	311		6th	3	813
	2d	6	647	6.0 @ 6.5	1st	1	335
	3d	9	524		2d	1	200
3.5 @ 4.0	1st	1	290		3d	6	317
	2d	8	271		4th	1	380
	3d	4	754		5th	1	275
4.0 @ 4.5	1st	3	215		6th	5	1,062
	2d	4	386		7th	1	840
	3d	4	281	6.5 @ 7.0	1st	1	410
	4th	12	538		2d	1	260
	5th	2	825		3d	1	180
4.5 @ 5.0	1st	2	240		4th	4	600
	2d	2	460		5th	1	1,085
	3d	4	439	7.0 @ 7.5	1st	3	400
	4th	5	777		2d	3	562
	5th	3	758		3d	2	140
5.0 @ 5.5	1st	1	390	7.5 @ 8.0	1st	1	325
	2d	2	885		2d	2	145
	3d	3	908				

From the theory of Mr. Login, before quoted, the inference is drawn, that when flowing water is saturated, or loaded in proportion to its velocity with sediment, the erosion and caving of banks will cease. In this is involved the assumption that the erosive power is that of friction rather than of impact. Surveys have been made by the Mississippi River commission which show the relative amount of caving on the right and left banks below Cairo. In this part of the river the line of demarca-

tion between the muddy discharge of the Mississippi, following the right or west bank, and the clear water from the Ohio along the left or east bank, is apparent at times to the eye for twenty or thirty miles, and to the sediment trap for ten times this distance. At Columbus, twenty miles below Cairo, the amount of sediment per unit of measure has been observed three or four times greater on the west than on the east side of the river. But these comparative surveys show that the caving on the right or west bank, washed by the muddy water, is greater, both in length of bank and in area and bulk, than it is on the opposite shore, where the water is undercharged with sediment. The length of river from which this conclusion is drawn (230 miles) is thought to be great enough to eliminate any local or abnormal influences on velocity, or material of bank.

B. M. Harrod.

AMERICAN CLIMATOLOGICAL ASSOCIATION.

The second annual session of the American climatological association was held at the hall of the Academy of medicine in New York, May 27 and 28; the president, Dr. A. L. Loomis, in the chair. This association was organized a year ago in Washington, for the study of climatology and diseases of the respiratory organs.

In the opening address, on the afternoon of the 27th, the president expressed the opinion that the scope of the society's work ought to be enlarged, so as to include the study of affections of the vascular system and other diseases, as well as to investigate more systematically the subjects of sanitaria and of mineral springs. This suggestion was afterwards adopted.

In Europe the study of these subjects had gone much farther than in America, and it was becoming more and more common for European physicians to treat their patients by prescribing residence for greater or less time at sanitaria especially adapted to their diseases. That such was not the case in America was not due to the lack in this country of the climates which possessed the necessary beneficial qualities, but to the lack of systematic study of the subject by the medical profession, as well as to the imperfect provision for the wants of invalids at our health resorts. The attempt to remedy these deficiencies was one of the main objects of the association.

As a model of what was desirable to encourage in the way of sanitaria, the president described one in the Adirondacks, devised to meet the wants of invalids of limited means, where, for a small sum, accommodation is provided in cottages for two or four patients, with a common dining-hall; also tents, etc., for those who are able to camp out; the whole under the charge of a medical board and an attending physician.

After speaking of the causes of pulmonary phthisis, Dr. Loomis said that the objects to be accomplished in the treatment of the disease are two, — to improve the general condition of the patient; and to stop the local disorder in the lungs, preventing the entrance and multiplication of the bacilli tuberculosis. Good climate is a potent means of accomplishing both these ends. Good climate means pure air, and it must be determined by clinical experience.

The amount of moisture in the atmosphere is not an index; for the only dampness injurious to the phthisical patient is that exhaled from the soil, laden as it is with organic matter. The nature of the soil is therefore of prime importance. It must be light and porous, admitting of good drainage. A clayey soil is necessarily bad.

Dr. Beverly Robinson of New York read a paper on antiseptic inhalations, instancing cases in which he had obtained decided benefit, especially in the way of alleviating cough by this method of treatment. The vapor of antiseptics was applied by means of a respirator worn over the nose or mouth, or both, from one to two hours a day in some cases, and nearly all the time in others.

'Catarrhal affections of the nasal cavities as a cause of pulmonary phthisis,' was the title of a paper by Dr. W. C. Jarvis of New York. The position taken was, that consumption can be traced, in many instances, to a catarrhal condition of the larynx, which in its turn is induced by the irritating effect of the discharges from the pharynx and nasal cavities, the catarrhal condition in this situation being due to a deflected nasal septum. In the discussion which followed, it became evident that the members present were not in accordance with Dr. Jarvis's novel views.

The event of the evening session was the presentation, by Dr. H. F. Williams of Brooklyn, of his pneumatic cabinet, with histories of cases of consumption treated therewith. The cabinet consists of an air-tight iron safe, with a plate-glass front, perforated near the middle with an opening about an inch in diameter, through which passes a rubber tube, so arranged that the patient can hold the end of it in his mouth as he sits upon a low stool in the cabinet. When the cabinet is closed, this tube forms the only means of communication with the external atmosphere. The patient having taken his seat, and placed the end of the tube in his mouth, the door of the cabinet is closed, and the air within slightly rarified by means of a few strokes of an air-pump. By this process the body is surrounded by a rarified atmosphere, while the respiratory passages are in communication with the outer air: the patient is therefore breathing from an atmosphere of greater density than that surrounding his body, with the effect of expanding the chest, bringing the lower part of the respiratory organs into play, and affording valuable exercise of muscles of respiration. Dr. Williams also claims that with its aid antiseptic sprays and vapors can be carried much deeper into the lungs than by any other method. The paper and demonstrations excited much interest, and a number of gentlemen expressed them-

selves as deeply impressed with its value as a therapeutic agent.

Dr. F. C. Shattuck followed with an exceedingly interesting and scholarly paper upon the home treatment of consumption.

The morning session on the 28th was opened by a paper from Dr. Ch. Dennison of Denver, Col., upon a rule for the even division of climate. The ground was taken that dryness and elevation are the most important elements of climate in the treatment of consumption.

'The problem of acclimatization' was the title of a paper read by Dr. I. H. Platt of Brooklyn. The question of acclimatization, although a long-vexed one, had never been satisfactorily dealt with, partly, no doubt, because most of the discussion antedated the advances of recent years in the sciences of biology and anthropology, especially as developed by the great principle of evolution. Facts were adduced to show the perfect adaptation of races to climates widely differing from their own, and which are at first injurious to them. The acclimatization of the Spanish race in Peru, and of the French in Algiers, were cited as examples. The whole subject was but an application of the fundamental law of biology enunciated by Herbert Spencer, — that of adaptation to environment. In the adaptation of a race to new surroundings, the principle of natural selection would play an important part. And the author took the ground, that, even in the acclimatization of an individual, the same law would find application, as the protoplasmic elements of the body would be subject to it in their growth and development. The author called attention to the exceedingly complicated nature of the problems presented by the action of the many elements of climate upon the human organism, and the modifications and reactions effected therein, and the importance of their more thorough and systematic study.

The public session in the afternoon was opened by Dr. J. C. Wilson of Philadelphia, with a paper upon the climate of Florida; and Dr. Keating, also of Philadelphia, followed with a paper upon the same subject. Both gentlemen took substantially similar views, Dr. Keating dwelling principally upon the climate of southern central Florida. This region is characterized by sandy soil, pine woods, and continual sunshine. The climate is more equable than that of the northern portion of the state. The counties of Orange and Orlando are the most favorable spots. There are good hotels, fine drives, and all the facilities for comfortable living. The summer as well as the winter climate is desirable. The doctor much preferred the central portion of the peninsula to either coast as a health resort.

Dr. E. Darwin Hudson, jun., treated of the results of the home treatment of consumption, contrasted with those of changed residence and climate, and presented cases in his own experience in which he had obtained favorable results where, for some reason, change of climate was inadmissible.

'Hay-fever and allied affections' was the title of the contribution of Dr. F. H. Bosworth of New York. A brief sketch was presented of the history of the various theories in regard to the causation of hay-fever, — first, that it is caused by the pollen of ragweed and other plants; second, Dr. Beard's theory of a nervous tendency, which he claimed was hereditary; third, the theory of Dr. Daily of Pittsburgh, that it was caused by hypertrophy of the nasal mucous membrane. Neither of these elements alone is capable of producing the disease: it is the effect of all three acting together; and the removal of any one is sufficient to cure the disease. The most practical and radical method, however, is by attacking the hypertrophied mucous membrane. The doctor explained the action of the hypertrophied membrane in causing the disease by its tendency to cause partial occlusion of the anterior nasal passages, in consequence of which the effort of inspiration produces a rarefaction of the air behind the partially occluded portion of the passage, thus, by a process analogous to dry-cupping, producing turgescence of the local blood-vessels.

Dr. D. M. Cammann closed the proceedings with a history of the stethoscope, and the presentation of a modification of the Cammann stethoscope devised by himself.

A reception was given in the evening by the New-York members to the non-resident members. The papers read before the association will be published in full at an early date in the *New-York medical journal*.

The following officers were elected for the coming year. President, Dr. William Pepper of Philadelphia. First vice-president, Dr. Frank Donaldson, Baltimore. Second vice-president, Dr. Beverly Robinson, New York. Secretary and treasurer, Dr. J. B. Walker of Philadelphia. Council, Dr. E. D. Hudson, jun., New York; Dr. E. T. Bruen, Philadelphia; Dr. J. H. Tindale, New York; Dr. J. C. Wilson, Philadelphia; Dr. F. H. Bosworth, New York.

CURVED BACILLI IN AIR AND WATER.

MR. J. HERICOURT (*Comptes rendus*, 1885, p. 1027) gives some interesting results of his investigations on the nature of curved bacilli, and their presence in the atmosphere. The researches were made during the recent cholera epidemic; and the following are his results: —

1°. In all water, no matter what its source (spring-water, from cisterns, running, or stagnant), there are curved bacilli of varying form and size, among which those of the same type as the cholera bacillus are constantly found.

Of the various waters examined, some were taken from localities absolutely free from cholera; others were examined very lately, when the disease no longer existed; and most of them were used for drinking-purposes, and were of perfect quality.

2°. The constant presence of these micro-organisms in all kinds of water can only be explained by supposing the existence of their germs in the air; and to test this, atmospheric dust was collected from dif-

ferent places, as from gardens, rooms, barracks, sick-chambers, stables, and out-houses. With this dust was sown neutral *bouillon* sterilized by heat, and cooked potato, with the result of finding many curved bacilli in all the cultures.

3°. The curved bacilli do not exist in their characteristic form in 'atmospheric dust:' they are there present in the germ or spore condition. In fact, if this 'dust' be examined immediately after dilution with sterilized distilled water, very few curved bacilli can be made out; and these are hardly recognizable as such, being changed in appearance by the development of one or more spores at their ends, or somewhere in the middle of the rod. This sort of change is precisely what is seen in cultures. If what happens in these drops of diluted dust be observed from day to day, the number of curved bacilli will be seen to vastly increase until the third or fourth day, when the spore formation recommences.

4°. The presence of curved bacilli in water, and of their spores in the air, furnishes a sufficient explanation of the presence of these organisms wherever air or water can penetrate.

Intestinal dejections in simple diarrhoea, as well as in dysentery and typhoid-fever, broncho-pulmonary secretions in all diseases of the lungs, from simple catarrh to advanced tuberculosis, pus exposed to the air, the saliva of a sick or well man, — all substances, in fact, which can nourish the germs of bacteria, contain the curved bacilli, and oftentimes in much greater number than the other bacteria, which are also found in such culture-media. The mud of the streets, made up of dust and water, can also be considered to be a favorable medium in which they are numerous and active.

5°. These micro-organisms are decidedly *aérobie*, and only flourish on the surface of liquids. They are mobile, moving with the rapid oscillations of vibrios, and very refractive. They are easily colored by methyl violet in watery solution, and, thus stained, show all the described forms, — commas, curves, omega, S, spirals, etc. In general, they are from one-half to two-thirds as long as the bacillus of tuberculosis, but are thicker and less regular than these: in fact, no peculiarity of form or staining distinguishes them from the bacilli found in cholera dejecta. Sowing the *bouillon* with dust proves that the spores, whose formation was observed as above, are their *resting* stage: moisture seems to be the condition indispensable to their perfect development.

6°. Collected first on *bouillon* or cooked potato, and then cultivated on nutrient gelatine, these curved bacilli form rounded colonies with serrated edges composed of highly refractive granules. These colonies, kept at 20°–22° C., grow in the gelatine, and liquefy it, finally producing a colony of the shape of a glove-finger.

7°. Until conclusive inoculation experiments shall be made, proving the pathogenic properties of the curved bacillus of cholera, the conclusion to be reached is, that these latter are the same as are found in all secretions, normal or pathological, provided these have come in contact with water, which is the normal habitat of curved bacilli, or with air, which furnishes transportation for the germs.

[These experiments are exceedingly interesting, but no proof is offered to show the exact correspondence of the curved bacilli spoken of, with those of cholera. Johne's work (*Science*, June 5, 1885) speaks of the distinctive difference between Koch's comma bacillus and that of Finkler and Prior; and this latter will answer to all of the description given by Hericourt of the curved bacilli he has observed.]

HYPODERMIC INJECTION OF CULTURES OF CURVED BACILLI.

IN a paper on the effects produced in man and animals by the ingestion and hypodermic injection of cultures of the bacteria of choleraic diarrhoea (*Comptes rendus*, 1885, 1148), are given some interesting results obtained by Bochefontaine in experiments made with cultures obtained from choleraic diarrhoea in peptonized gelatine.

The first generations were found to liquefy the gelatine with a cup-shaped depression terminated by a deep point. None of the cultures contained the curved bacillus alone; but always, and in greater number than this, were found rods or spirilla fully developed. There were never found in the cultures the very short, rapidly moving bacteria which filled the watery discharges in cholera. Every successive generation showed an increase in the number of the simple curved bacilli.

I. The author has on four different occasions swallowed pure cultures of the curved bacillus of the third and fourth generation without ill effect.

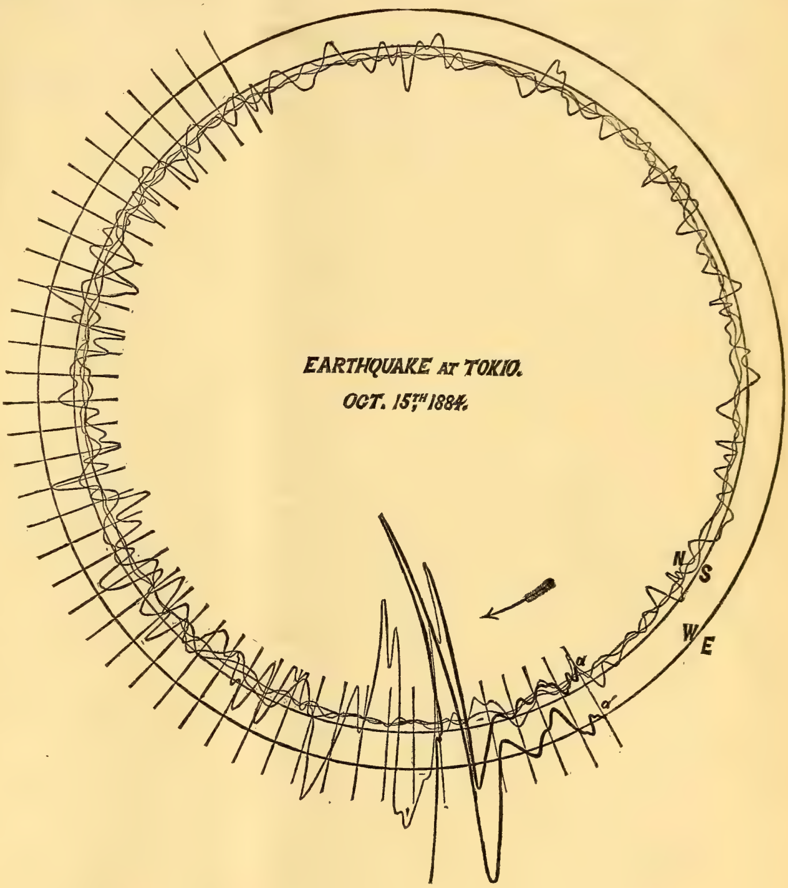
II. Two adult guinea-pigs were inoculated in the flank with a fourth of a centimetre of a mixture of equal parts of water and gelatine containing the culture: both were found dead the next morning. The autopsy showed great effusion on the inoculated side and opposite abdominal wall, with nothing in the internal organs. Two other guinea-pigs were inoculated with an eighth of a centimetre of the same mixture, and the smaller one died in twenty-four hours, with appearances similar to the first two. The second showed no symptoms. Microscopic examination of the blood of the three dead animals showed nothing. The same injection was made in two larger guinea-pigs, with no result.

III. The experimenter injected three-fourths of a centimetre of the mixture under the skin of his left fore-arm, with the result of much oedematous swelling and some pain, with deep fluctuation in the region of the puncture, three days afterwards. Black blood obtained from this point showed no bacteria, either microscopically or upon cultivation.

The inferences that the writer draws are, that the ingestion of the cholera microbes produces no unpleasant symptoms; that their hypodermic injection will produce local symptoms if in sufficiently large dose; and that the blood of man and animals under normal conditions will destroy cultures of the bacteria of choleraic diarrhoea.

A RECENT JAPANESE EARTHQUAKE.[1]

AN unusually great earthquake was felt in and about Tokio on Oct. 15, 1884. The annexed autographic record of it comes, with the following particulars, from my former assistant, Mr. K. Sekiya, who is now in charge of the seismological observatory of the University of Tokio. It was given by a horizontal pendulum seismograph of the kind recently described in *Science* (iv. 516), and it has many features in common with the examples of records shown on p. 517 of the same volume. But in the present case the amplitude of the earth's horizontal movement far exceeds any thing that has been recorded since observations of this kind were instituted, in 1880.



The figure shows the record reduced to about one-third its actual size. The undulations on the inner circle have been traced by a pointer which registered the north to south component of motion, and those on the other circle by another pointer, which registered east to west motion. The pointers are prolongations of horizontal pendulums, and trace their records on a revolving sheet of smoked glass, which in this example was started into motion by the earthquake itself, through the agency of a delicate electric contact-maker. The plate is driven by a clock-work train, which, after starting, quickly reaches a steady rate under the control of a fluid friction governor. The speed of rotation was one revolution in eighty-two seconds. The short radial lines mark seconds during the first part of the disturbance. The record on the outer, or east to west, circle, has been turned round so as to bring it into synchronism with the inner, or north to south, record; and the earliest motions are distinguished in the cut by the use of a somewhat heavy line. The records begin at *a* and *a′*, and are traced in the direction of the arrow, which is opposite to the direction of motion of the glass plate. At *b* the east to west record comes to an abrupt stop, owing to the displacement there having been so great as to carry that pointer off the plate altogether. The inner record extends over nearly four complete revolutions, showing that visible motions of the ground lasted for about five minutes. During the first half-dozen seconds, while both components were being registered, there is a tolerably close agreement of phase between the two, showing that the displacements were then not very far from rectilinear. The greatest motion in this part of the disturbance took place five seconds from the start. At that point the actual motion of the ground was 3.7 centimetres from east to west, and 2.2 centimetres from south to north. The displacement of the ground is multiplied four times in the original record, or about one and a third times in the reduced copy given here. The two components taken together represent a movement of the ground, from one side to the other, of no less than 4.3 *centimetres*, — a quantity which is in striking contrast to the '5 or even 7 *millimetres*' which, after three years' experience, I named as the amplitude to which in a Yedo earthquake the displacement from the mean position 'occasionally rises.'

So far as can be judged from the north to south component alone, the most violent motions were over in about ten seconds; but for some minutes afterwards, the oscillations, though very much re-

[1] From *Nature*, April 23.

duced, continued to exceed in amplitude almost any that I have recorded.

Fortunately, however, this earthquake was prevented from being excessively destructive by the unusual slowness of the oscillations. The period of the principal movements appears to have been not far short of two seconds. For a rough estimate of the greatest velocity and acceleration, we may treat the 4.3 centimetres movement as simply harmonic; and we find for the greatest velocity 6.8 centimetres per second, and, for the greatest acceleration, 21 centimetres per second, or $\frac{1}{47}$ of g. If the amplitude of motion which was recorded here had occurred in conjunction with the more usual period of three-quarters of a second or so, the destruction would have been immense. The earthquake appears to have been felt over an area of about twenty thousand square miles.

Mr. Sekiya writes, "We are going to exhibit your seismograph in the exhibition in London, to be held next May. I am sure we will get a first-prize medal."

Whether Mr. Sekiya and the Tokio university authorities get their medal or not, they should at least excite admiration for the zeal and success with which they are pursuing the study of seismology.

J. A. EWING.
University college, Dundee.

ELECTRIC LIGHTING ON SHIPBOARD.

A PAPER recently presented to the British institution of civil engineers by Mr. Andrew Jamieson gave rise to an exceedingly interesting and instructive discussion. The author of the paper considered the advantages of the electric light on board ship to be summed up in the following points: its healthfulness; freedom from heat, odor, or gaseous products; its general agreeableness; its freedom from danger of setting fire to combustible material; removal of the danger of storage of inflammable illuminants; avoidance of the nuisance of cleaning and refilling lamps; reduction of space occupied by total plant; and a fair competition in cost of illumination.

The dynamo should be placed with its axis in the fore and aft line, in order to reduce the gyrostatic effect caused by rolling, and thus to lessen the heating of its bearings. It should be capable of developing the required electromotive force at its regular speed; should be self-regulating; should not 'spark;' should not heat the conductors when running light; should contain, either in its own coils or in the conducting system, not less than ninety-six per cent pure copper; and the system should have an insulation resistance of not less than ten thousand ohms per volt, generated at the regular speed of working. The speed is generally preferred to be under six hundred or six hundred and fifty revolutions per minute. Higher speeds demand more careful supervision, give rise to danger of heated bearings and sometimes of bursting the armature, cause objectionable gyrostatic action in uneasy ships, and make it difficult to drive by direct connection.

The engine should be capable of driving continuously and indefinitely as to time, without danger of heating or break-down. Its governor should control the speed within five per cent,[1] with variation of steam-pressure of ten pounds or more per square inch, and a variation of load of ninety per cent, i.e., with full load, or with nothing on but the dynamo. A tachometer, or continuous speed-indicator, is a valuable adjunct to the engine as exhibiting all variations of speed. An electrical governor acting upon the throttle-valve is thought to be a desirable instrument.

When not driven directly, the dynamo is, as a rule, connected to its engine by cotton rope, the steel-wire coiled belting coming into use in the United States not apparently having been introduced into Great Britain. The Westinghouse engine is reported to be doing excellent work. Brotherhood's 'three-cylinder engines,' and the Tower 'spherical engine,' are also working satisfactorily. Friction pulleys have been used, in some cases, instead of belting, for indirect connection.

The system of distribution is usually one of two principal kinds: in the one method, a set of return wires is used; in the other, the hull of the ship takes the return currents. The latter system is the less costly and more easily fitted, and gives rise to less resistance: but it has the disadvantages that a fault in the leading wire has more effect than in the other, a contact with the hull short-circuiting the current; it is more likely to be injured by leakage of salt water upon the conductor, in which event corrosion goes on with serious rapidity; but care in protecting the wires, and in placing them, reduces the danger from these causes to a very small quantity.

It is of great importance that the junctions of wires should be very carefully and thoroughly soldered; and the size of wire should be such that it should give at least a square centimetre area per fifty ampères, according to the rule of Sir William Thomson. But the author of the paper would adopt the rule: Make the conductivity of the wire not less than ninety-five per cent that of pure copper, and give it a cross-section of a square millimetre for an ampère and a half of current, or about a square inch to a thousand ampères; the insulation resistance of the whole circuit, including switches, etc., to be not less than a thousand ohms per volt of electromotive force of the dynamo. Failures are usually due to neglect of the precaution of testing the insulation when the plant is put in place. Safety-wires, to prevent the overheating of any part in case of wires crossing, should always be introduced.

The size of lamp should be ten-candle power for staterooms or 'cabins,' twenty-candle power for the saloons and larger rooms, and fifty to a hundred candle power for above-deck illumination. Arc-lamps of ten thousand to twenty thousand candle power are used on men-of-war for illuminating the surroundings of the ship, and for protection against the unobserved approach of torpedoes.

[1] In the United States, a variation of two per cent is considered too great.

TEN KATE'S EXPLORATIONS IN WESTERN AMERICA.

AFTER devoting himself for a number of years to the special study of somatology, and also to the more general acquirements necessary for an ethnologist, Dr. H. Ten Kate, jun., born in La Hague, set out on different expeditions to study some tribes and nations *in natura*. He accompanied Prince Bonaparte to Lapland and Finland in the summer of 1884, and in the present year has undertaken an extensive trip to Surinam, aided by subsidies from a number of scientific societies. The expedition which he undertook through the south-west of the United States and the north-west of Mexico was performed in the space of about thirteen months, — from November, 1882, to December, 1883, — and resulted in many valuable discoveries and observations, described by him at length in his recent volume written in Dutch, 'Reizen en onderzoekingen in Noord-Amerika' (Leiden, *Brill*, 1885, 464 p., 8°), with map and two plates containing views, portraits of Indians, etc. Having reached the west through Texas and Arizona, he first paid a visit to Sonora, and the southern extremity of the Californian peninsula. He found there graves of the Pericú Indians, whose skulls and bones proved them to belong to a race anthropologically distinct from the Cochimi, and other tribes farther north in the same peninsula. He left that dry country to pass through Sonora again, and north to the Gila River, to the Mohave reserve on Colorado River, to central Arizona, to the Pápago and Apache-Tinné settlements in the same territory, to Zuñi and the Pueblos of New Mexico scattered along the Rio Grande. The aboriginal tribes last seen by him were the southern Utes and the tribes in the centre and the east of the Indian Territory. We easily understand that the space of thirteen months was but a short lapse of time, considering the immense area travelled over, and the large number of Indian tribes and other objects of ethnologic interest which came under his observation; but, in reading the long and interesting report, we must acknowledge that the traveller has made the best use of the opportunities offered him. There is an endless variety of remarks on botany, geology, zoölogy; on Indian dresses, customs, pictographs, color adjectives; on government, politics, history, and political economy of the countries visited. We also meet at times with a few pungent remarks on the traders, cowboys, politicians, and 'judges' in the far west, — observations which greatly help to brighten the narrative, and enhance the interest we take in it.

Several smaller articles auxiliary to this report were issued by Dr. Ten Kate before its appearance. Their purpose is to give scientific accounts of Indian craniums, bodily admeasurements, tribal names, etc.: they are written in French.

THE GLACIAL PERIOD IN AUSTRALIA.

IN a paper on this subject recently read to the Geological society of London, Dr. R. von Lendenfeld said, that, although several previous writers have suggested that bowlders and gravels found in different parts of Australia are of glacial origin, the evidence is vague, and no clear proof of glaciation has been brought forward. During a recent ascent of the highest ranges in Australia, — parts of the Australian Alps, — where he discovered a peak which he named Mount Clarke, 7,256 feet high, he found traces of glaciation in the form of *roches moutonnées* throughout an area of about a hundred square miles. The best preserved of the ice-worn surfaces were found in a valley named by the author the Wilkinson valley, running from north-east to south-west, immediately south of Müller's Peak and the Abbot Range. No traces of ice-action were found at less than 5,800 feet above the sea. The rocks showing ice-action are all granite; and the fact that the surfaces have been polished by glaciers is said to be proved by the great size of such surfaces, by their occurrence on spurs and projecting points, by many of them being worn down to the same general level, and by their not coinciding in direction with the joints that traverse the rock. Dr. von Lendenfeld's paper closed with a comparison of the evidence of glacial action in Australia with that in New Zealand.

Prof. T. G. Bonney considered that more evidence was necessary in order to establish the point contended for by Dr. von Lendenfeld. All his proofs were founded on granite, which had a constant tendency to form rounded bosses. The fact that the supposed *roches moutonnées* occurred on spurs, rendered the matter still more doubtful, seeing that in small glaciated tracts such surfaces were chiefly found in valleys. It was a remarkable, and to him a very suspicious, fact that no moraines or perched blocks were noticed: in fact, the only point of importance adduced in favor of the author's view seemed to be the difference in the direction of the joint-planes and of the rounded surfaces; and this he thought insufficient.

Mr. W. T. Blanford agreed with Professor Bonney, and mentioned examples of the occurrence in the plains of India, where glaciation was out of the question, of granite surfaces simulating *roches moutonnées*, and of larger dimensions than those cited by the author. It seemed to him not impossible that Dr. von Lendenfeld was right; but the evidence brought forward was certainly not sufficient. The circumstance most in favor of a glacial origin for the supposed *roches moutonnées* was their restriction to a particular elevation.

THE RECENT CHOLERA CONFERENCE IN BERLIN.

AT the recent cholera conference in Berlin, May 2–8, the principal disputants were Koch and Pettenkofer, the former asserting, and the latter denying, the specific character of the so-called 'comma' bacillus of cholera.

The following summary of the position of each, taken from reports that have just reached us, may be of interest to our readers.

Koch's grounds for his assertions he sums up as follows: 1. The constant occurrence of the bacillus

in seventy-nine cases of cholera examined in Calcutta. 2. He demonstrated pure cultures of the comma bacillus from France, Italy, and Germany, all exactly alike. 3. He considers it proven that this comma bacillus occurs only in cholera, may be differentiated from others similar to it, and is diagnostic of the disease. 4. He demonstrated inoculation experiments upon animals, as follows: —

Five cubic centimetres of a five-per-cent solution of sodic carbonate, and in twenty minutes ten cubic centimetres of meat-broth containing a pure culture of the comma bacillus, were injected into the stomach of each guinea-pig. Immediately afterwards laudanum (one centimetre for each two hundred grams weight) was injected into the abdominal cavity. This served to narcotize the animals for one-half an hour to one hour. The next day they were ill, with bristling hair, great weakness of the hind-legs and muscles of the back, and died in from one to three days. Section showed swelling of the intestinal glands, and the stomach and coecum full of an alkaline, colorless, flocculent fluid, containing almost a pure culture of the comma bacillus. This experiment was made upon eighty-five guinea-pigs.

Similar experiments were made with Finkler and Prior, and Denecke's bacillus, but in much smaller number. The results were very different, Finkler's bacillus producing putrefaction in the intestinal contents, as shown by their smell.

Therapeutic experiments upon the inoculated animals showed merely that large doses of calomel, or the use of naphthaline, would prolong the life of the animal for a day at most. The comma bacillus is easily destroyed by drying and other disinfectants, as by a one-half-per-cent solution of carbolic acid.

The observations upon man, considered by Klein and Macnamara to be of the nature of infection experiments, Koch took up again, and showed, that, of the one hundred and fifty physicians who took the 'cholera course' in Berlin, but one had cholerine, and comma bacilli were found in his dejections.

He has also found that the comma bacillus will live in well-water thirty days, in dirty canal-water seven days, twenty-four hours in the contents of a privy, three to four days in moist linen, eighty-one days in the harbor-water of Marseilles (Nicati and Rietsch), and more than one hundred and forty-four days on agar-agar. Koch has never found any *resting* form at all like the spore stage of some other bacteria.

Pettenkofer confessed himself not convinced. He said the inoculation experiments were unsatisfactory. Those made with Emmerich's short staffs at Naples and at Munich were much more so. The manner in which Koch inoculated his animals threw no light upon the subject, for only man had the disease. He cannot agree that the comma bacillus is more than a usual accompaniment of cholera. The epidemiological knowledge of cholera is to be completed by considering the comma bacillus its cause, — a difficult thing to prove, since drying kills this organism; and yet in lower Bengal a dry year is notoriously a favorable one for the disease.

The comma bacilli are found only in the intestines, not in the organs; and yet the intestinal glands are highly absorptive. Cholera is not a combination of infection and intoxication, but an infectious disease, pure and simple. It is possible that in the future Emmerich's staffs may be found to be the cause of the disease. These are found in the organs of the inoculated animals, and produce cholera-like vomiting and diarrhoea. Before fully accepting the bacillus, more must be known of the epidemiology of the disease. Since cholera is not communicated directly, so the cholera-germ is not; and, since cholera depends upon place and time, the cholera-germ must be governed in the same way.

ROLLESTON'S LIFE AND WORK.

ROLLESTON'S worthiest memorials are the growing school of biology at Oxford, and the important zoölogical and anthropological collections of its university museum. His remarkable energy, however, enabled him not only to do his work as a teacher, and take the part of a leader in university politics, but to add to knowledge by investigations in many subjects. His original papers, dealing with topics pertaining to anatomy, physiology, zoölogy, archeology, and anthropology, are scattered over the pages of different journals, and the reports and transactions of various societies. It is well that some of his friends have collected these scattered writings, and secured their republication in the volumes before us. Professor Turner of Edinburgh has edited them; and Prof. E. B. Tylor of Oxford has added a brief biography, which is full of interest as giving a clew to the source of the remarkable influence which Rolleston was able to exert in favor of natural science, at a time when the traditions, and the preponderance of the sentiment of his university, were against such studies.

Rolleston's father, vicar and chief land-owner of a small Yorkshire parish, was a good classical scholar, and undertook the primary education of his son, who, it is said, was able to translate Homer at sight when only ten years of age. The lad had, from the first, something of the tastes and instincts of the naturalist: he read Izaak Walton, and Gilbert White's ever-charming 'Selborne,' and in his play-hours mounted the skeletons of mice and weasels, and stuffed the skins of birds and beasts of the neighborhood. After subsequent years at school, he won a classical scholarship at Pembroke college, Oxford, and began residence in

Scientific addresses and papers. By GEORGE ROLLESTON, M.D., F.R.S., Linacre professor of anatomy and physiology, and fellow of Merton college. 2 vols. Oxford, *Clarendon press*, 1884. 76+947 p., portr., illustr., 5 pl. 8°.

his eighteenth year. He seems to have been unusually boyish for his age. A contemporary records "how young he was in every way, beginning at first sight to tell with schoolboy frankness all about his study at Sheffield, how he furnished it, how the boy next him had died, and how he had read all his Greek plays." The master of Pembroke did not trouble himself concerning the unsophistication of his new scholar. He said, "He is a clever Yorkshire-man; and, when a Yorkshire-man is clever, he *is* clever."

In 1850 Rolleston graduated with a first class in classics, and next year he was elected a fellow of his college. His fellowship was only tenable on the condition that he should graduate in medicine within a certain period. Oxford affording at that time even less opportunity than now for medical studies, he went to St. Bartholomew's hospital in London. After completing his professional course he worked with notable success for a time in the English hospital at Smyrna, towards the close of the Crimean war. In 1857 we find him settled in London, and assistant physician to the hospital for sick children. Extracts from letters written at this period show him entirely devoted to his work, and interested not merely in his little patients, but endeavoring to promote the welfare of their parents. "I see a good deal of the London poor by this means, and, though I find among them much stupidity and brutishness, I nevertheless see more of qualities which are estimable. Love and self-denial I see constantly, and I make it my business to encourage these qualities."

Rolleston's career was not, however, to be that of a successful London physician. His character, his talents, and his learning were not forgotten at Oxford; nor had he lost his love for his university. Before he had practised a year in London, the Lee's readership in anatomy, and the post of assistant physician to the Radcliffe infirmary, fell vacant, and Rolleston was elected to both. For some time after returning to his *alma mater*, he was hampered in the performance of his teaching duties by the necessity of practising medicine to make a sufficient income; but in 1860, being then in his thirty-first year, he was elected to the Linacre professorship of anatomy and physiology, just endowed by Merton college. This position he held for the rest of his life. Once freed from the cares and distractions of a physician's life, Rolleston's future career was that of an earnest teacher and investigator, and protagonist in the weary war which biology had to wage in Oxford, year after year, before it could obtain any standing in the university less galling than a begrudged and contemptuous tolerance.

When Rolleston was appointed Linacre professor, the Oxford museum was being organized against much opposition, partly on financial grounds, but mainly because a powerful group of university leaders had aroused the sentiment that natural phenomena should only be studied from an artistic or emotional standpoint. The beliefs of this group were, that there was something degrading, if not absolutely obscene, in the study of the bare facts of anatomy and physiology; that skulls of early races of mankind were disagreeable objects, which no well-bred person would ever look at but through the semi-translucent atmosphere of history and poetry; that organic nature could never interest any one possessing refined feelings, except when a hazy glamour had been thrown around it by the discoloration and distortion of naked facts by mental spectacles of 'sweetness and light;' that the objective study of the question, how man came to live, and move, and have his being, was not only irreligious (which might be pardoned), but ungentlemanly, and therefore inexcusable. The forces and feelings against which Rolleston had to contend, are hard to picture in imagination now, but they were then very real and vigorous. Ten years after the foundation of the Linacre professorship, an Oxford man told us that all the natural-science students in Oxford called themselves mathematicians; and even mathematicians were regarded with contempt by the average undergraduate, whose boyish aestheticism led him to gently coo that 'culture' was all in all, and literature its only road. Against this sentiment Rolleston had to work. He had personally experienced that a student who intended to adopt the profession of medicine was heavily handicapped if he gave up three or four years of his life, after leaving school, to the sole study of Greek and Latin. As one excelling in classical scholarship, and skilled 'in all the learning of the Egyptians,' he could command a respectful hearing, even from the most conservative supporters of the eighteenth century Oxford curriculum. His indisputable excellence as a scholar, his eloquence, his energy, his executive ability, his genial nature, his universally recognized honesty of purpose, and hatred of all sham or subterfuge, enabled him to do what, perhaps, no other man of his time could have done; namely, obtain at Oxford a tolerably fair recognition of the value and importance of biological study.

No one can bring about a great reform, unless in a social medium already somewhat prepared for it. It was Rolleston's good fortune to work at a time when his efforts were not mere hopeless assaults on a fortress rendered impregnable by prejudice. He battled at an epoch when many sympathized with him, and were ready to help. But it is his glory to have been the leader, exceptionally fitted by natural gifts and academic career, to conduct to victory those who desired to widen the range of Oxford studies. To him, more than to any other one man, is it due that in biological teaching the university on the Isis is now pressing close on the heels of her sister on the Cam.

PROFESSOR MARSH ON THE DINOCERATA.

OF late years Professor Marsh has been following the plan of selecting a certain group of extinct vertebrates, and thoroughly elucidating its structure in an exhaustive monograph. Where practicable, this plan is by far the most satisfactory method of dealing with the subject; but it seldom falls to the lot of a paleontologist to obtain his materials in the necessary abundance. The volume before us is a magnificent one, surpassing in many respects all other paleontological works. Never before has such a remarkably perfect series of mammalian fossils, illustrating a single group, been brought together. Only in the tertiary lake-deposits of western America could such a collection have been formed; but few can realize what an expenditure of time, labor, skill, and money, even under the most favorable circumstances, is represented by the raw material of this work. Had Professor Marsh done nothing beyond collecting, he would still be entitled to the lasting gratitude of all biologists.

The introduction gives a short but sufficient account of the geology of south-western Wyoming, the only region where remains of the Dinocerata have been found. The section illustrating this part is open to serious criticism, in that it substitutes for the long-established names of formations given by Hayden, King, and Powell, new terms derived from some characteristic fossil. Such arbitrary changing of accepted names can only result in 'confusion worse confounded.' This section refers the Laramie to the cretaceous, whereas it is almost certainly tertiary. The Puerco is altogether omitted.

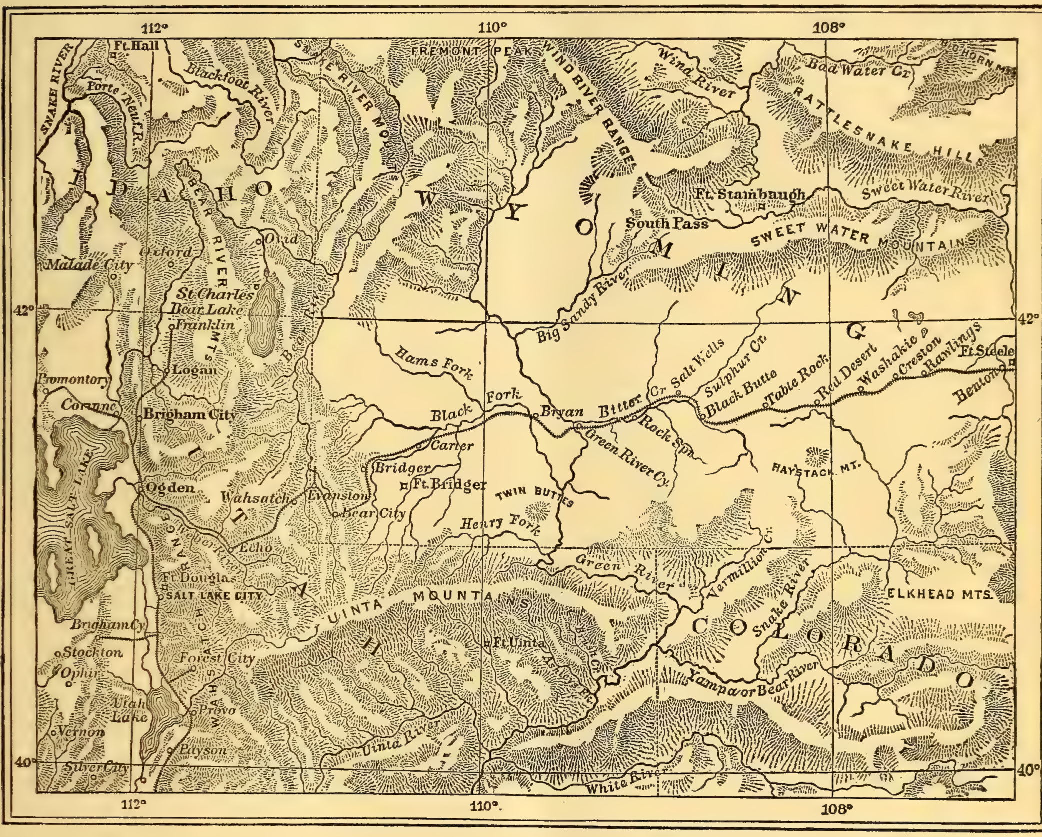
The Dinocerata: a monograph of an extinct order of gigantic mammals. By OTHNIEL CHARLES MARSH. U. S. geological survey. Monogr. Vol. x. *Washington,* 1884. 237 p., 56 pl.

The descriptive part of the book opens with a chapter on the skull, in which the most curious part of these most curious animals is illustrated with much care. A remarkable and novel feature of this chapter is the series of sections of the skull which it presents. These sections are made in all directions, — transverse, vertical, and horizontal, — and thoroughly display the internal structure of the skull, the sinuses, cranial cavity, olfactory chambers, as well as the characters of those bones which cannot be seen from the surface. Professor Marsh has here indicated a new method of investigation, which is certain to yield valuable results in the future, as it already has in his hands. Strange to say, the description of the skull ignores almost entirely the basi-occipital, sphenoidal, and periotic regions, as well as the foramina at the base of the cranium. These are most important features, and their omission detracts materially from the value of the chapter. The lower jaw receives very thorough description and illustration: its chief peculiarities are the backward projecting condyles, and, in the males, the anterior flanges, for the protection of the great upper tusks. Professor Marsh shows that in the females these tusks were very small, and that in consequence the flanges of the mandible are absent or rudimentary; thus correcting the very natural error into which Speir and Osborn had fallen in regarding the flange as a generic instead of a sexual character.

The chapter on the teeth need not detain us except to notice the lower incisors and canines. Osborn and Speir first showed that these teeth differed from those of all other ungulates in having bilobed crowns. In his restoration of 'Tinoceras' and elsewhere, Professor Marsh represents these teeth as having a very different shape, though the only actual specimen he figures (woodcut 38, p. 37) is an evidently much-worn canine; of 'Dinoceras,' he gives figures of three isolated incisors. We must believe that the restoration of these teeth in 'Tinoceras' is erroneous.

Certainly one of the most striking and valuable chapters in the book is that on the brain. The brain in the Dinocerata "was proportionately smaller than in any other known mammal, recent or fossil, and even less than in some reptiles. It was indeed the most reptilian brain in any known mammal." This is a most remarkable and unexpected fact. This chapter is enriched by an extended and valuable series of cranial casts of mammals from nearly all the tertiary formations. Lartet first pointed out the comparatively small size of the brain in the

tertiary mammals; and his results have been confirmed by Cope, Bruce, and others, but by no one with such a wealth of illustration as by Professor Marsh. The latter's generalizations, however, are somewhat vague, and not altogether novel, and in one case inaccurate. Professor Marsh says, 'All tertiary mammals had small brains.' While such is the general law, it has conspicuous exceptions; as in the lemur Anaptomorphus, described and figured



by Cope, and in some miocene mammals. Of the latter Professor Marsh's selection is not the best to bring out the facts. Aside from this, Professor Marsh's assemblage of facts is of the utmost importance, and well worthy of careful study.

Chapters v.–xii. are taken up with full and accurate descriptions of the trunk, neck, and limbs. No point of importance is left in doubt, and we may be said to know the osteology of the Dinocerata almost as fully as that of any recent group of mammals. Such completeness of material, and fulness of detail, constantly excite the reader's admiration.

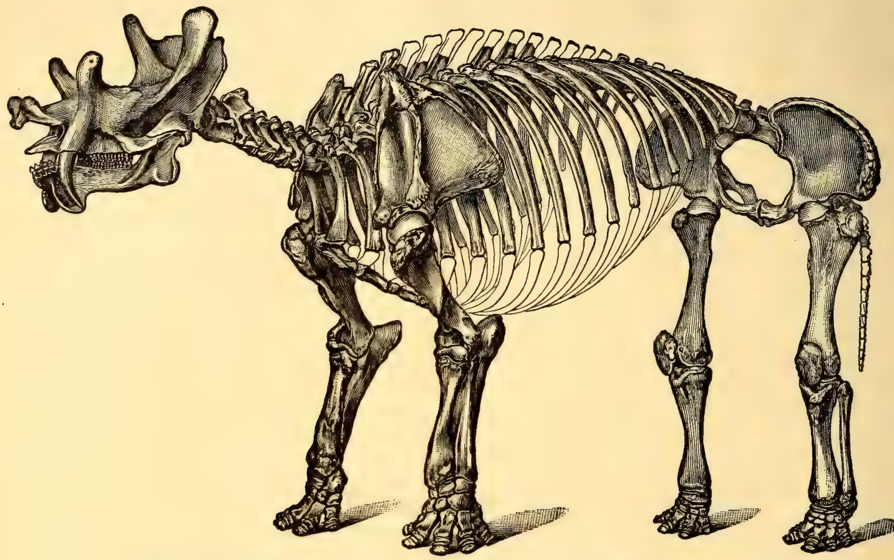
Chapter xiii. deals with the restoration of the Dinocerata, and will be read with great interest; and the two superb folding plates which illustrate this chapter have never been approached in the general accuracy of the separate parts, or in the beauty of drawing. In the figure of Dinoceras, however, the humerus is incorrectly drawn, and we believe that the fore-limb is too much flexed (compare plate 28, fig. 2).

The general conclusions form the least satisfactory section of the work. Lack of space forbids any full analysis of this chapter, but some portions of it demand notice. In the main, the scheme of classification of the ungulates here proposed agrees quite closely with that made by Professor Cope (*Proc. Amer. phil. soc.*, 1882, pp. 435–447), though with some manifest improvements. No acknowledgment of this agreement is made, however, and the reader would not suppose that Cope had ever written on the subject. When the latter proposed the order Amblypoda, including Coryphodon and the Dinocerata, Professor Marsh rejected it in these words: "A careful consideration of the characters of Coryphodon, so far

as now known, indicates that the genus represents a distinct family of perissodactyl ungulates, the Coryphodontidae. The skull is clearly of this type, and the skeleton and feet present no differences sufficiently important to justify a separation from that natural order" (*Amer. journ. sc. and arts*, 3d ser. vol. xiv. p. 84). Yet in the present volume he adopts the order under the name of Amblydactyla. But the proposed new terms, Amblydactyla, Coryphodontia, Holodactyla, and Clinodactyla, are all synonymes of earlier names, and cannot be adopted. This volume is, we believe, unique among modern scientific works in not containing a single reference in the text to the work of others, and the reader never knows how much of the book has already been anticipated. There is, it is true, a scrupulously exhaustive bibliography appended; but, as few can plod through such a mass of pamphlets, injustice cannot be avoided by this method.

In conclusion, a few words as to the classification of the Dinocerata. The genus first to be named was the Uintatherium of Leidy: the Tinoceras and Dinoceras of Marsh, and the Loxolophodon and Eobasileus of Cope, were described at later dates. As far as the evidence in this volume goes, these names all refer to the same genus, which, of course, must be called Uintatherium. The shortness of this article will not allow us to attempt to prove this proposition, but we believe it capable of satisfactory demonstration. It is, however, a matter of slight importance.

The plates of this volume are beyond all praise. They are drawn with the utmost fidelity, and at the same time are most beautiful specimens of artistic skill. In this respect they may challenge comparison with any similar work. The printing and type leave nothing to be desired, and the numerous finely executed woodcuts add much to the clearness of the text. Notwithstanding, then, all that we have found to criticise, 'The Dinocerata' is a splendid piece of work, which is an honor to American scientific enterprise.



RESTORATION OF TINOCERAS INGENS MARSH. ONE-THIRTIETH NATURAL SIZE.

REPORT OF THE U. S. ENTOMOLOGIST FOR 1884.

WORKERS in economic entomology look forward with especial interest to the appearance of the annual report of the U. S. entomologist. The bureau under his charge is the only institution devoted to this department of science, which is liberally supported; and therefore it is rightly expected that this report shall be the most important contribution to applied entomology during the year.

The report before us, contained in the report of the department of agriculture for 1884, consists of a hundred and thirty-four pages, illustrated by ten plates. The more important articles in the body of the report treat of kerosene emulsions, the streaked cottonwood leaf-beetle, the southern buffalo gnat, and the cranberry-fruit worm. There are appended to the main report several reports by special agents.

The article of most general interest is that

treating of kerosene emulsions; and we are glad to see considerable space devoted to 'words of caution and advice' as to the dangers attending their use: for it can hardly be said that the discussions of the kerosene question in these reports have been heretofore conducted "in the spirit of an investigator, and not in the spirit of an advocate."

The experiments with kerosene, and the invention of devices for applying insecticides, have been the characteristic features of the work of the bureau during the past four years. This work has been of great importance; but it is hard to see on what grounds the late commissioner of agriculture claimed that "the chief remedies and insecticide appliances now quite generally employed with satisfaction, and constantly discussed and recommended in the agricultural press, have originated during my administration of the department" (p. 13).

The successful introduction of Apanteles glomeratus, a parasite of the imported cabbage-worm, is one of the most practical results of the work of the bureau; and the working-out of the life-history of the cranberry-fruit worm is also important. The article by Mr. Hubbard, on the rust of the orange, is very complete, except that nothing is said to lead the reader to think that any thing has ever been published before concerning this disease. This is the more surprising; since we find, that, although the mite which is supposed to cause the rust is carefully figured, the name given to it by Ashmead five years ago is nowhere used in the report. The creature is referred to as simply 'the rust-mite,' or as 'the mite.'

The illustrations are not so good as we have learned to expect in these reports. Of the figures on the ten plates, nearly one-half are reproductions, and the original figures are nearly all photo-engravings. The photo-engraving processes are a great boon to impecunious investigators who cannot afford to employ engravers; but in a small report, which is almost the only visible result of the expenditure of a vast sum of money, we have a right to look for something better. It is due to the artist, however, to say that the new figures bear inherent evidence of truthfulness.

In looking at the report as a whole, we find much in it of value, but still not so much as might fairly be expected when we consider the large number of entomologists employed (we think, fifteen), and the size of the appropriation made to the bureau (nearly $30,000 for the year ending June, 1884). It is true that the entomologist complains that the work of the bureau has outgrown its present means of putting results before the public; but this complaint would have more force if he were more economical of the space at his disposal. If the bureau has accumulated large additions to knowledge which are of great interest to the agriculturists of the country, why devote what is more than one-fourth of the report to an article on cabbage-insects, the greater part of which is a compilation from sources which are easy of access? or why devote seven pages to republishing an address on 'General truths in applied entomology'?

NOTES AND NEWS.

AT a meeting of the American society for psychical research held in Boston, June 4, a report was made by the committee on thought-transference which covered a discussion of the results of the experiments upon guessing digits and the colors of cards, which were described in a circular issued by the society during the winter. A large number of returns were received, but no evidence was obtained of the existence of thought-transference among ordinary persons for such matters as the value of a digit or the color of a card. Prof. E. C. Pickering of the Harvard-college observatory also presented a discussion of the observations taken at the observatory in the revision of the star catalogues, — observations in which it was supposed that some thought-transference might take place, as the recorder knew the magnitude of each star as given in the Durchmusterung before he received the observer's estimate. If thought-transference existed, this fact might have an influence upon the observer's mind; but no evidence of this influence was found in a discussion of some ten thousand observations. One of the members of the society has met with some success in the reproduction of drawings after the plan of the English society. The committee on mediumistic phenomena made a brief report, stating that they had visited a number of mediums, and had arranged several private *séances* on their own terms, but had met with nothing satisfactory; they will, of course, continue their work, as will the other committees of the society.

— Reports are received from the Pacific coast of unusual damage by insects destructive to crops. Locusts, presumably Camnula pellucida, are just now very destructive in the unfledged condition in some ten counties of California, especially in the San-Joaquin valley. The genuine Hessian-fly is also doing much damage to the grain districts embraced in a line drawn from Vallejo in Solano county to Benecia, thence to Suisun, thence to Napa City, and back to Vallejo; also in parts of Sonoma county.

— The *Athenaeum* states that the Russian traveller Piassetsky, who accompanied Col. Sosnoffsky on his journey through China and Mongolia in 1872, and a translation of whose travels was published last year by Messrs. Chapman & Hall, is about to set out on

a second journey to China. The Russian papers announce that he recently showed the drawings and paintings, made during his earlier tour, to the emperor and empress, who expressed themselves much interested in the prospects of his second journey of exploration. Piassetsky owed his escape from several unpleasant predicaments, during his former travels through the Middle Kingdom, to his skill as a draughtsman; and it is hoped by his compatriots that he will be able to turn this advantage to better account, now that he can follow his own course without the interference of a superior officer like Col. Sosnoffsky, with whom, on the last occasion, he continually disagreed.

— At the annual meeting of the Iron and steel institute in London, Mr. Andrew Carnegie of Pittsburgh contributed a paper on natural gas-fuel and its application to manufacturing purposes, the information being much the same as that contained in his recent article in *Macmillan.* In the discussion which followed, Mr. J. H. Bell said there was a possibility of Cleveland, Eng., competing with Pennsylvania in the matter of natural gas, as in other matters, as the salt-beds evolved a certain quantity of gas, and, if the borings were continued several hundred feet farther, would probably give more. At the last day's meeting, Dr. Herman Wedding of Berlin contributed a paper on the properties of malleable iron, in which he said that microscopical investigation had led him to modify the explanation of welding he had given some years ago. He had now come to the conclusion that the strength of a finished piece of iron depends on the sectional area of the mass of iron it contains. From the total sectional area of a piece of weld iron, the slag inclusions, and in the case of ingot iron the blow-holes, must be deducted. This calculation is decidedly in favor of the ingot iron, though he pointed out it can only be superficially effected, even with our present knowledge of microscopy.

— A valuable illustrated note on the Huron (Dakota) tornado of Aug. 28, 1884, has just been issued by the signal-service: it is the work of Sergeant S. W. Glenn of the signal-corps. Imagine, the author says, a vast treeless plain, void of hill or dale, and a sultry atmosphere beneath a sky unobscured save by small drifting cumulus clouds and a narrow band of stratus cloud in the north-east. Suddenly a commotion is observed in the cumulus clouds which have piled up in a woolly mass in the north, as though checked by some invisible barrier separating them from the horizon by a strip of clear sky. Then there is a rapid and confused whirling: the centre of the mass drops down bowl-shaped, and appears as if making futile efforts to touch the earth. At the same time, a conical cloud of dust is seen to accumulate on the ground, and acquire a rotary motion. With the swiftness of thought, the upper cloud drops a considerable distance downward, and spins out a white, ribbon-like line towards the ground. The connection between the earth and cloud being established, it remains stationary for a moment, apparently gathering strength before starting on its career of destruction. Then it moves rapidly over the plain, destroying every thing in its path. A number of cattle and horses were taken from a herd, lifted bodily high in the air, and churned together in a living mass; thirty steers and four horses were killed, and more were wounded; most of the beasts appeared to have their lower jaws dislocated. The tornado crossed the Dakota River, taking up the water so suddenly as to leave the bottom exposed for an instant: the water was carried to a great height, and was not seen to fall; but heavy rain, with some hail, occurred twelve or more miles to one side of the track. Mr. Glenn is of the opinion that the centre of the tornado was a nearly complete vacuum, and that the governing factor of the storm was electricity; but he does not state how electricity could produce or maintain the vacuum, and he gives too brief consideration to the dynamic effects of the whirling air at the centre of the tornado funnel.

— A party of five persons — consisting of Drs. E. G. Gardiner and H. M. Buck of Boston; Mr. G. H. Barton, assistant at the Massachusetts institute of technology; and Messrs. Bartlett and Burlingham of the junior class of the institute — has just started on a summer's expedition, under Prof. A. Hyatt, to the west coast of Newfoundland for zoölogical and geological explorations. The party sailed in the Arethusa, a small schooner belonging to Professor Hyatt, which he has used in connection with the summer school at Annisquam. Professor Hyatt left some weeks ago for St. John, N.F., where he has been visiting the museum, and securing charts and a pilot. He will join the party at Cape Breton.

— During the years 1870 to 1879, the meridian circle of the Harvard college observatory was largely employed in the revision of the Durchmusterung for the zone between the parallels of declination at +50° and +55°. The star-places employed as points of reference in the work were taken from the list given in publication xiv. of the *Astronomische gesellschaft,* and various stars were also observed for purposes not connected with the revision proper. In a quarto pamphlet of nearly one hundred pages, and extracted from the forthcoming volume xv. of the annals of the observatory, Prof. W. A. Rogers, who has himself made nearly all of the observations, and has had charge of their reduction and publication, makes the results of the entire work immediately available in the form of a catalogue of the right ascensions and declinations of 1,213 stars. The catalogue proper is preceded by the annual results for the fundamental stars, while the data of the catalogue itself are derived from a discussion of the results obtained during the whole period covered by the observations.

— M. K. Olzewski communicated to the French Académie des sciences, on the 6th of April, a paper on the liquefaction and solidification of formine and of nitric acid. Cailletet stated that he had first made known the procedure for the liquefaction of these gases and their use in a condensed form for obtaining the liquefaction of oxygen. Olzewski, by preparing products free from acetone and hydrogen, has succeeded in obtaining a white, snow-like mass.

SCIENCE.

FRIDAY, JUNE 19, 1885.

THE LICK OBSERVATORY.

The Lick observatory, in its present condition on the summit of Mount Hamilton, California, is so nearly completed, with the exception of the great telescope, that the institution may now be sketched to advantage in its permanent form. In an early issue of *Science*, therefore, this enterprise will be traced through its various stages, from the inception onward. Astronomers have been slow to avail themselves of the great advantages of mountain elevation and isolation in the prosecution of astronomical research, partly because of the pecuniary outlay attending the necessary expeditions, but chiefly because some of the earlier expeditions to mountain summits were not attended with results of especial importance, and, on good theoretical grounds, the meteorological conditions of such stations appeared likely to be so unfavorable as to counterbalance fully the advantages to be derived from mere elevation. And besides, the evidence derived from the two most famous expeditions — that of Prof. C. Piazzi Smythe to the Peak of Teneriffe, and of Mr. William Lassell to Malta — was so contradictory in character as to afford very good ground for abandoning the hope of immediate advantage to astronomy from superior elevations.

It is not possible to say how far Mr. James Lick was acquainted with these endeavors of scientific men ; nor need the immediate circumstances or events which impelled him to his extraordinary astronomical bequest be considered here. Professor Newcomb points out the fact that his movement followed close upon the completion of the great Washington telescope in 1873, then the largest in existence. Had Mr. Lick known the opinions of the best astronomers on the subject of mountain observatories, and the likelihood of securing, on elevated and isolated peaks, results at all commensurate with the trouble and expense of occupying such stations, he would have found very little to encourage the project. In this case, however, as very often before, a little experience has proven to be worth more than an indefinite amount of scientific theorizing. It has been said that the scheme of building "a powerful telescope, superior to and more powerful than any yet made," was the nearest of all to the heart of Mr. Lick : there is abundant evidence that this is true ; and it may be also true that he regarded the observatory as an appendage of the telescope. But the course of subsequent events has proven it a matter for sincere gratulation in astronomical circles, that he ever regarded either the observatory or the telescope at all ; for, had not the prospective researches with the great telescope arrested his attention, there is very little reason for believing that, in so far as he was concerned, astronomical science would ever have been in a position to reap benefit from the splendidly equipped observatory which already exists on the summit of Mount Hamilton.

That Mr. Lick was bound, heart and soul, in the project, not only of a great telescope, but of the best possible location for it, is evident from the fact, that when nearing his eightieth year, and although oppressed with physical infirmity, he resolutely undertook a wagon-journey of some forty miles or more, reclining on a mattress, all for the sake of investigating a proposed mountain site in person. His solicitous concern for the enterprise was very marked. Those who knew him best say, that, if his practical knowledge of astronomy had been greater, he would have given every penny of his vast fortune for the great telescope, and the observatory and its endowment. He would have recognized, too, the great improbability of such an institution being completed within a period of a few short years,

and would thus have been led to provide for the reasonable use of the instrumental equipment as fast as it was put in place on the mountain. The failure to make such provision constitutes the chief point of unfavorable criticism on the part of astronomers, and is in many respects unfortunate; but sundry advantages also have arisen from it, which may be recognized with more profit, particularly as this condition of things must remain unalterable until the great telescope is completed, and the entire institution comes under the administration of the University of California, in full accord with the terms of Mr. Lick's bequest.

Five years ago no one could have anticipated that the year 1886 must pass with the great telescope still unfinished. It is worthy of note, however, that, while the delay in obtaining the necessary glass for the objective has proven so great an embarrassment to the work of the opticians, it has not as yet sensibly impeded the progress of the construction of the observatory itself. To this fact we alluded at page 377 of the current volume of *Science*, stating as well the very reasonable grounds for the belief that the plans of the Lick trustees, in so far as they pertain to the construction of the great telescope and the conjoined observatory, will be completely executed at the close of the year 1887. With its unparalleled instrumental equipment, and an unusual endowment for the prosecution of astronomical research; located where the sky is cloudless most of the year, and at such an elevation as to be above the clouds a great part of the remainder; and situate in a region, too, where the steadiness of the air permits astronomical measurement of the highest precision to proceed uninterruptedly throughout the entire night for months at a time, — the Lick observatory is destined, under prudent management, to take its place at once in the foremost rank; and, although it is the first established mountain observatory, it may well expect to hold its own in the emulation of similar institutions which may subsequently be inaugurated at greater elevations.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A new standard cell.

SINCE October last I have made some experiments on the zinc-alkali-copper oxide cell with a view to determine the practicability of some modification of it.

The fact that copper and iron, and perhaps some other metals, dissolve in potassium (or sodium) hydrate when used as cathodes, suggested to me the possibility that the formation of the alkaline cuprate might occur at a definite and practically convenient difference of potential between the electrodes immersed in the alkaline bath. As a matter of fact, I find that a cell mounted with amalgamated zinc, potassic hydrate, and metallic copper, gives, when charged until a blue color appears, a deflection of a hundred and seventy divisions on the scale of a Thompson galvanometer; the Daniell, mounted with saturated zinc sulphate and copper sulphate, giving a hundred and fifty-six divisions. The zinc-alkali-copper cell is joined by a double key to charging-cells and to the galvanometer, a resistance of over nine thousand ohms being included in the circuit of the latter.

The proper shunt is, of course, employed. This deflection of a hundred and seventy divisions seems to be invariable, and the cell experimented upon promises to be a desirable practical standard of electromotive force. Its excellence appears to consist in the fact that the cuprate produced breaks up before it diffuses to the amalgamated zinc, depositing oxide of copper, which settles. The zinc is suspended about an inch above the copper, — which is a spiral ribbon, exposing about two square feet of surface, — and the resistance is less than an ohm. I have used a ten-per-cent solution of 'depurated' potassic hydrate. After some trials, it is found that the shifting of the cell from the charging source to the galvanometer circuit may be done leisurely, as the electromotive force does not seem to begin to fall off for some minutes. Further testing of the effect of changes of temperature, strength of solution, etc., is in progress. Thus far, the temperature of the cell has been allowed to vary very little, not enough to affect the readings. I offer this preliminary note as of possible interest to your readers. This type of cell would be admirably adapted to furnish any desired multiple of its electromotive force.

F. C. VAN DYCK.

Rutgers college, New Brunswick, N.J.
June 13.

Real and imaginary Americanisms.

Your correspondent, whose identity is perhaps scarcely concealed by initials, is quite right in saying (*Science*, June 5, 1885, p. 454) that the peculiar use of 'get' in Sir William Thomson's lecture is not an Americanism. But he is not equally correct in his remarks concerning 'would' and 'should.' It is true that speakers in the west of this country are apparently unable to use these words as they are used by writers of classical English, but the same peculiarity is one of the most marked characters of the English of Scotland, as shown in the current burlesque of it: 'I will be drowned, and nobody shall save me.' The confusion may be reaching England, as your correspondent remarks, but not from America. Sir W. Thomson has not 'caught the prevalent epidemic:' it was doubtless born and bred in him.

E. W. C.

THE GINKGO-TREE.

AN event of considerable interest to botanists has just occurred at Washington in the flowering, for the first time, of two of the ginkgo-trees in the U. S. botanic garden.

In passing the grounds on Saturday evening, May 6, after the gates were closed, my attention was attracted to a tree standing just inside the enclosure, which, though as yet nearly leafless, was loaded with staminate aments borne in terminal clusters on very short branchlets all along the branches, even down to the base of the larger ramifications. A glance showed that it was a ginkgo, though I had never seen one in flower before; and, after examining it sufficiently, I went away, and was obliged to wait until Monday morning before I could notify the superintendent, Mr. W. R. Smith, and institute a search for other trees in the same condition.

Presuming that, as is usually the case in public gardens and parks, all the trees in the city would also be males, so that no opportunity would exist for witnessing the fruiting of this tree, I was most agreeably disappointed when I learned that Mr. A. L. Schott had found another tree in flower in the same enclosure, and that this tree was a female. I thereupon carefully inspected both these trees, and found that anthesis was so nearly synchronous in the two sexes that I was able on the 5th to pronounce them ready for fertilization. But as they stand some seventy-five yards apart, with the superintendent's house and other obstacles between them, it was evident that this could not take place unaided; and accordingly, with the hearty co-operation of Mr. Smith, the work of artificial pollinization was undertaken. This has been repeated several times at different hours of the day, and so thoroughly performed that it is hoped the result will be successful,[1] and that fruit will be borne this season.

The so-called Japanese ginkgo,[2] or maiden-hair tree (Ginkgo biloba, Linn.; Salisburia adiantifolia, Smith), is one of the most interesting trees that have been introduced into the landscape plantations of Europe and America. Although possessing deciduous foliage and broad green leaves, it nevertheless belongs to the Coniferae, though its affinities with the rest of that family are anomalous, being closest with the yew tribe. An examination of its leaves shows them to be wholly unlike those of any other phenogamous plant. They are deltoid in outline, and the fine nerves that run from the narrow base to the broad apex fork several times in their course, after the manner of ferns. In fact, a ginkgo leaf very closely resembles a much enlarged and thickened pinnule of the maiden-hair fern (Adiantum), — a resemblance which not only suggested to Smith the specific name adiantifolia, but has caused the tree to be popularly called in some localities the maiden-hair tree.

A study of the paleontological history of this remarkable plant reveals the fact that it is an archaic form, and the sole survivor of an otherwise extinct type of vegetation which had numerous representatives in the remote geologic past. The Salisburia adiantoides of Unger, found in the upper miocene of Senegal, is not essentially different from the living species; and Professor Heer detected it again in the miocene strata of Greenland. In 1881 I was so fortunate as to obtain from Laramie strata at Point of Rocks Station, Wyoming Territory, a form which, except for its smaller leaves, appears to be identical with the living one; and in 1883 I found in Fort Union strata, on the lower Yellowstone, a slightly different form, with larger leaves, showing no lobes, proving that the present living form has come down to us, almost unchanged, from a period as remote at least as the cretaceous age. But other and distinct forms are found in the cretaceous, and still others, showing greater and greater divergence, as far back as the Jurassic; those of the oolite bearing clear evidences of having been derived from a series of still older, digitate-leaved forms (Jeanpaulia, Baiera, etc.) whose relationship with the ginkgo was not suspected until these intermediate ones had been brought to light by Heer from the mesozoic rocks of Spitzbergen and Siberia. In fact, until recently these earlier Jurassic forms, which had been long well known, were from their nervation referred to the family of ferns; as, indeed, a fossil leaf of the ginkgo would probably be now, if the living plant were unknown.

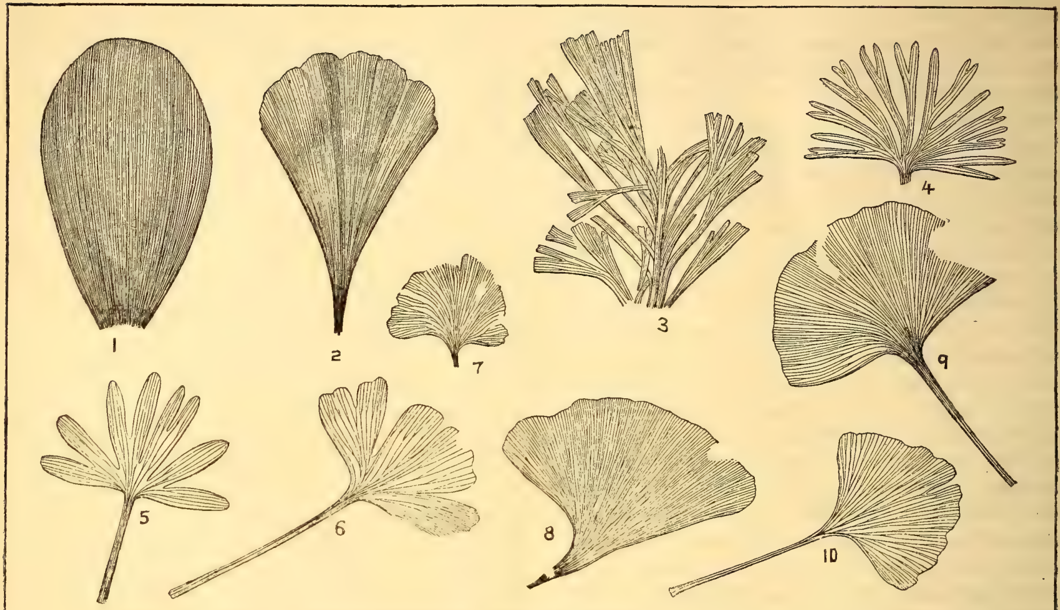
But even this is not all. By another series of far more ancient forms (Trichopitys, Psygmophyllum, Noeggerathia), this persistent type may be traced still farther back, even across the boundary between mesozoic and paleozoic time, until, in the great carboniferous flora, it has been connected, almost without

[1] Evidence is abundant (June 15) that artificial pollinization was successful.

[2] The orthography of this word is not settled. Linné (Mantissa plantarum, Holmiae, p. 313) wrote *ginkgo*, as did also, apparently, Kaempfer before him (Amoenitat. exotic., 1712), and as all botanists since have done, and do still; but nearly all lexicographers reverse the consonants, and write *gingko*, usually without explanation. Littré alone, of all I have consulted, gives both spellings. In the supplement to Webster's dictionary the word is said to signify silver-fruit, and it would seem that the etymology ought to determine the orthography.

question, with the abundant and so long enigmatic Cordaites. This ancient plant was formerly regarded as the forerunner of the family of cycads; but now, in the light of these discoveries, it is almost universally regarded as coniferous. It was one of the earliest types of land vegetation to appear on the globe, running far back into Devonian, and even into Silurian time.

The figures of the accompanying plate, kindly drawn for me by Ensign Everett Hayden, U. S. navy, have been selected with a view to illustrating the phylogeny of the genus Ginkgo: and they are numbered, and as nearly as practicable arranged upon the plate, in the order of supposed development, from the true Cordaites to the living Ginkgo biloba; this being also, as will be observed, substantially the chronological order of their appearance.



PHYLOGENY OF THE GENUS GINKGO.

1. Cordaites lingulatus, Grand'Eury: carboniferous, Central France. 2. Psygmophyllum (Noeggerathia) flabellatum (Lind. & Hutt.), Schimp.: carboniferous, England. 3. Ginkgophyllum Grasseti, Saporta: Permian, Hérault. 4. Baiera (Jeanpaulia) Münsteriana (Presl), Heer: rhaetic, Bayreuth. 5. Ginkgo Sibirica, Heer: oolite, Siberia (restored by Heer). 6. Ginkgo digitata (Brongn.), Heer: oolite, Cape Boheman, Spitzbergen. 7. Ginkgo Laramiensis, n. sp.: Laramie, Point of Rocks, Wyoming Territory. 8. Ginkgo (Salisburia) adiantoides, Unger: Fort Union beds, lower Yellowstone. 9. Ginkgo (Salisburia) adiantoides, Unger: miocene, Greenland. 10. Ginkgo biloba, L.: living, Washington, D.C. All the figures are reduced one-half.

The broad leaves of some species of Cordaites, though more or less elongated or elliptical in shape, possess a nervation strikingly similar to that of the later ginkgo-like forms; while the familiar fruits so abundant in the coal-measures, and which are now known to be those of Cordaites, resemble in an equally remarkable manner the almond-shaped nuts borne by the present maiden-hair tree.

Though these carboniferous plants were at first commonly regarded as cycadaceous, still the long, ribbon-like leaves of certain cordaitean forms (Poa-Cordaites of Grand'Eury) led some eminent authors, including the late Professor Göppert, to consider them monocotyledonous, and the precursors of our lilies, reeds, grasses, and also of the palms. But even these mistakes have not been without their uses. It is the peculiarity of science that in its very errors knowledge is extended. The theory that Cordaites was cycadaceous was not wholly false; the suggestion that it might be monocotyledonous contained a 'soul of truth;' and the present opinion that it was coniferous is, I venture to assert, not wholly true. The truth lies in the midst of all these opinions. It seems to be this: there were no true paleozoic Cycadaceae, monocotyledons, nor Coniferae; but Cordaites was the prototype of them all. It was in the Trias, whose flora is unfortunately the least known of all the formations in past time, that all these definite types of vegetation were differentiated from this comprehensive type, — the Cycadaceae through their Macropterygiums

and Pterophyllums; the monocotyledons through their Aethophyllums and Yuccites; and the Coniferae through their Albertias, Walchias, and Voltzias; while the less modified ancestral type, which began even in the Permian to assume a distinct Salisburian aspect in the genus Ginkgophyllum, has come down to us, as already described, through the several successive modifications which culminated early in the tertiary in the modern form. This general form was somewhat varied, widely distributed, and quite abundant in miocene time; but it is now reduced to a single species, which was probably restricted to the warmer or more eastern districts of the Chinese empire before it was transferred by human agency, and acclimated in Japan, to which country it is now popularly credited. But it is said that there is now no part of the world in which it is found in a strictly wild state, being confined, even in China, to the near vicinity of temples and human habitations.

This interesting tree has for many years been cultivated on the continent of Europe, where it thrives as far north as Copenhagen, but only fruits freely in the more southern districts, notably in the botanic garden at Montpellier, France, where it has been exhaustively studied by Professor Charles Martins and the Marquis Saporta. In the United States there are now many fine trees; but they rarely flower, and, when they do so, the sexes are seldom together, so that fruit cannot be produced. The only exception to this known to me, or to any of whom I have inquired, is the case of a pair of these trees in the grounds adjacent to the University of Kentucky at Frankfort, which are in such close proximity to each other that fertilization regularly takes place, and fruit is borne.

It is owing to these circumstances that such special interest attaches to the coincident flowering this season, for the first time, of the pair of maiden-hair trees in the botanic garden at Washington; and the rare opportunity, should it be afforded, of witnessing all the steps in the reproductive process of this historic type of vegetable life, will be appreciated by both botanists and vegetable paleontologists.

LESTER F. WARD.

THE NEW CROTON AQUEDUCT.

THE necessity for an addition to the present supply of water of New York has been felt for many years, and the present Croton aqueduct, finished in 1842, has become entirely inadequate to meet the present requirements of the city. Never was the need of an additional supply better illustrated than in 1880, when the authorities in charge stated, at the end of a prolonged drought, that there was only fifteen days' supply at hand. Timely rains occurred shortly afterwards, and replenished the water-sources.

Since 1875, when two projects were presented for an additional water-supply, numerous surveys were made, extending in several instances beyond the limits of the present collecting-grounds; and in the beginning of 1883 a committee of citizens, appointed by the mayor at the request of the senate, presented to the legislature a report recommending that provision be made for the ultimate storage of all the water from the Croton basin, and for the immediate construction of a new aqueduct.

This scheme is now being carried out by a commission created by the legislature (May, 1883), and composed of the mayor, comptroller, and commissioner of public works, and of three citizens at large.

The available watershed of Croton River covers now 338.82 square miles. Its waters are at present collected in several storage-reservoirs, the lowest of which (Croton Lake) acts also as a settling-basin, from which the present aqueduct starts, and extends as far as the main distributing reservoir in Central Park. Owing to the limited capacity of the present storage-reservoirs and of the aqueduct, a very large proportion of the flow of the river is unavoidably wasted over Croton dam.

The present scheme consists in building reservoirs capacious enough to impound the copious spring flows, and in constructing a larger aqueduct, through which the necessary allowance of water can be drawn all the year round from the new reservoirs. It is consequently, in a general way, on a larger scale, a duplicate of the present system; but the very scale on which the work is to be built gives rise (as may be understood from the short description which follows) to many interesting and difficult engineering problems.

It is estimated, that, in the dryest years, the Croton watershed can furnish a daily supply of 250,000,000 gallons, equivalent to 100 gallons per head per day for a population of two million and a half souls, or to 75 gallons per head for a population of three and one-third millions.

In order to store the large amount of water necessary to provide this large daily supply during the dryer months, it has been found advisable to provide, at first, one reservoir of

very large capacity, placed low enough in the Croton valley to increase to 361.82 square miles the available area of the watershed of Croton River. This reservoir is to have a capacity of 3,200,000,000 gallons, — a body of water which would cover 9,400 acres ten feet deep.

The dam which is to form this reservoir (the Quaker-bridge dam), 178 feet high above the bed of the river, is to be built of solid masonry, and the water behind it is to be 171 feet deep. As the foundations of the dam must be extended to the bed-rock, a distance of nearly 100 feet below the bed of the stream, the total height of the masonry structure will consequently be not far from 300 feet for a length of 400 feet in the deeper portion of the valley. On both sides of this deeper portion the rock-bottom rises gradually, and the total length of the dam is to be about 1,300 feet.

The height mentioned for a masonry dam is unprecedented; and the strains which will be transmitted to the base of the structure by the combined action of its own weight and of the water-pressure are such as to require in the design a departure from the methods used and recommended by the engineering authorities who have studied the question of high masonry dams of lesser magnitude. The width of the dam at its base, although not fully decided upon, is to be more than 200 feet.

The question of providing an overflow to liberate the surplus water which must be wasted over the dam is happily and economically solved by nature, which has provided in the immediate vicinity a depression in the rock-formation, of the required elevation and form for the safe disposal of the freshets.

The new aqueduct starts from a point near the present Croton dam, and follows a general southerly direction towards the city, to 135th Street, with a length of nearly thirty-one miles. For the remaining distance, from 135th Street to the reservoir in Central Park (two and one-third miles), the water is to be conveyed in pipes. Harlem River is crossed by means of an inverted siphon 150 feet below the water surface.

With the exception of three points where it comes to the surface of the ground for short distances, the aqueduct is to be wholly in tunnel; and from the indications furnished by the topographical character of the country, and by numerous borings made with the diamond drill, it is probable that the excavation is to be, almost for the whole length of the aqueduct, in solid rock. It is expected that a large proportion of the tunnel excavation is to be lined with masonry; but, wherever the character of the rock is such that it can remain exposed without danger of falls, the masonry is to be dispensed with. If the line of work had been so located as to allow of the construction of the aqueduct in open trenches of moderate depth, it would have been much longer, owing to the necessity of following the contours of the land; and it would have passed along the east shore of Hudson River, through thickly settled communities, where the land-damages would have been much higher. The tunnel presents also the important advantage of being almost wholly safe from the attacks of a mob or of a military foe.

From Croton dam to a point south of and near the boundary of the cities of Yonkers and New York, the aqueduct has a maximum flowing capacity of 320,000,000 gallons per day: it is 13.6 feet high and 13.6 feet wide; and its section is that of a semicircular arch, supported on slightly concave sides, the bottom being formed by a flat inverted arch.

At the point just mentioned, where it is expected that a large distributing reservoir is to be built to supply the annexed district, and where consequently a portion of the supply is to be diverted, the flowing capacity of the aqueduct is reduced to 250,000,000 gallons per day, and its form is circular, with a diameter of twelve feet three inches.

This part of the aqueduct, over six and a half miles in length, including the inverted siphon under Harlem River, is to be heavily lined with masonry; and, owing to the insufficient elevation of the land, it is depressed to a considerable depth, presenting the peculiar, and to a certain extent experimental, feature of a masonry channel built in solid rock, and subject to a considerable internal water-pressure. Its prototype, the tunnel under Dorchester Bay, which conveys the sewage of Boston to Moon Island, has been in successful operation for more than a year, but under somewhat different conditions of location, size, and pressures.

For the purposes of construction and of future maintenance of the aqueduct, thirty-two shafts are provided, of various depths, the greatest being 350 feet. Twenty-four shafts are under construction, twelve of which are already completed, or nearly so.

Six extensive gate-chambers are to be constructed, in connection with the aqueduct, for the purpose of emptying it when necessary, and of regulating the flow of water from the

storage-reservoir into the city. One of them, at the head of the aqueduct, near Croton dam, is to be of unusual size, and is to be constructed to support a maximum pressure of 65 feet of water.

The aqueduct from Croton dam to Harlem River is now under contract to the amount of $11,900,000. The rest of the work is to be commenced shortly. A. FTELEY, C.E.

MEASURING THE CUBIC CAPACITY OF SKULLS.[1]

IN referring to the application of composite photography to craniological studies, Dr. Billings described the methods employed at the army medical museum in the preparation of such composites. They are made directly from the skulls, and not by combining separate pictures of individual crania. The skulls are adjusted in succession on the object-stand, in such a manner that the horizontal datum-plane adopted by German craniologists, and the subnasal and maximum occipital points (or the supra-auricular points in profile exposures), shall coincide; this being effected by movable frames on which are stretched a series of vertical and horizontal threads. It is very desirable that some uniform scale for the preparation of such photographs should be agreed upon by craniologists before the preparation of extended series is undertaken, and one-half of the natural size is suggested for this purpose.

These composite photographs should be studied in connection with the measurements of the crania included in them. It is a rapid and convenient means of obtaining graphic representations of a series of irregular objects, — representations which shall indicate not only the mean, but also, as far as possible, the maxima, of variations.

While something has been done in the study of the internal configuration of the cranial cavity, and more especially of the various fossae and projections at its base, with reference to their difference in various races, this field of inquiry is as yet comparatively unworked; and Dr. Billings thinks it very desirable to follow out this special line of investigation in connection with the large and valuable collection of crania of American races which now exists in the army medical museum and in the national museum. To do this, however, it is necessary that sections should be made of the skulls; and, before making such sections, it is desirable that all measurements, and especially the measurements of cubic capacity of these crania, should be made according to the best and most approved methods, and the results carefully recorded.

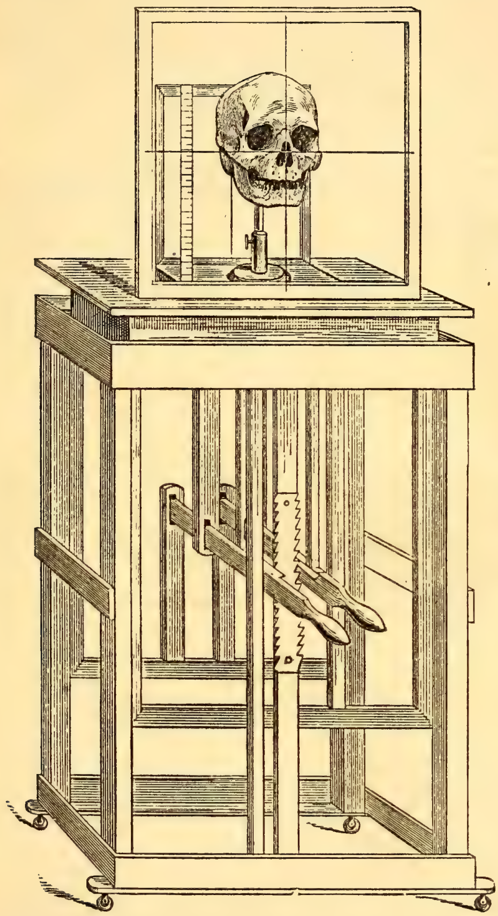
From the results of preliminary experiments upon the methods in use for measuring the cubic capacity of crania, Dr. Billings became dissatisfied with their accuracy, and accordingly requested Dr. W. Matthews to undertake a series of experiments for the purpose of obtaining, if possible, some more accurate and reliable method of ascertaining the cubic capacity. The following is an abstract of the report of Dr. Matthews, giving the results of his observations and experiments on measurements by means of water.

SIX ADULT MALE ANCIENT CALIFORNIANS FROM SAN NICHOLAS ISLAND.
Exposure of each skull 10–20 seconds, according to color.

Hitherto anthropologists have chiefly employed solid particles, such as shot or seeds, in the cubature of skulls. Water has been tried by former experimenters without success. Dr. Topinard, in his 'Élé-

[1] Abstract of a paper read to the National academy of sciences by Dr. WASHINGTON MATTHEWS, U.S.A. Presented, with introductory remarks, by Dr. J. S. BILLINGS, U.S.A.

ments d'anthropologie générale' (Paris, 1885), states that the chief difficulties with water are: first, that the water, wetting the sides of the measuring-glass, rises on it, and makes it impossible for the observer to read correctly; and, second, that the water penetrates to the sinuses and vacuoles of the skull, and returns, when the skull is drained, to augment unduly the water belonging to the cavity proper. The experiments of Dr. Matthews indicated that the great-



ELEVATING-TABLE, CRANIOPHORE, AND CROSS-LINE FRAME FOR ADJUSTING SKULLS IN COMPOSITE PHOTOGRAPHY.

est source of uncertainty lay in the fact that the skull, when moistened, increases rapidly in cubic capacity. His method is as follows: —

After recording the weight of the skull, it is varnished inside with thin shellac varnish, applied by means of a reversible spray apparatus. Artificial or accidental orifices are closed with India-rubber adhesive plaster. The foramina and fossae are filled with putty. The skull is wrapped in a coating of putty an inch or more in thickness, which renders it water-tight. It is filled with water by special apparatus in forty-five seconds, and emptied in fifteen seconds. The rapidity of this manipulation, in conjunction with the varnishing, prevents soaking into the sinuses, and the undue measurement of water which does not pertain to the cranial cavity. The water is poured into a measuring-glass of two thousand cubic centimetres capacity, and lycopodium is scattered on the water to define the true surface. The putty is taken from the skull: the latter is cleaned, and placed in a dry, warm apartment, until by slow evaporation it has been reduced to its former weight, and consequently to its former capacity. Then it is measured a second time to verify the results of the first measurement. The author did not claim rapidity as an advantage of the system, but believed that it removed to a great extent the effect of varying muscular effort, which was such a disturbing factor in other methods. "With the most important operations, the unchangeable element of time takes the place of the fickle element of vital force."

Although the method is new, and still susceptible of improvement, it is thought that the results as shown in the following table have not been excelled.

Comparative measurements of varnished and unvarnished skulls.

	Museum number of skull.	Unvarnished.			Varnished.			Date of measurement.	
		First measurement.	Second measurement.	Difference.	First measurement.	Second measurement.	Difference.		
		c.c.	c.c.		c.c.	c.c.			
1	199	1,400	1,390	10	1,400	1,400	–	March 26	April 2
2	359	1,450	1,445	5	1,450	1,450	–	" 23	" 3
3	362	1,275	1,270	5	1,270	1,265	5	" 26	" 2
4	373	1,455	1,455	–	1,450	1,450	–	" 24	" 2
5	375	1,305	1,305	–	1,300	1,300	–	" 24	" 3
6	481	1,455	1,455	–	1,445	1,445	–	" 24	" 2
7	1,516	1,160	1,155	5	1,160	1,160	–	" 23	" 3
8	1,914	1,285	1,280	5	1,285	1,285	–	" 27	" 3
9	1,915	1,450	1,440	10	1,440	1,435	5	" 21	" 2
10	2,034	1,200	1,195	5	1,190	1,190	–	" 26	" 2
S	um of	differ	ence.	45	. .	. .	10		

Average variation in unvarnished skulls . . . . 4.5 c.c.
Average variation in varnished skulls . . . . 1.0 c.c.

THE CULTIVATION OF MICROBES.[1]

It is possible to obtain a perfectly sterile liquid (that is to say, one deprived of all living germs) by one of four methods: —

1. Filtering through some material whose meshes are sufficiently fine to arrest the smallest organisms. The only material really practicable for this purpose is the unglazed porcelain used by Pasteur and Chamberland.

2. Obtaining the liquid directly from the internal organs of one of the superior animals; the digestive tract being considered, for this purpose, an *external* organ. Pasteur's experiments have shown that the

[1] Abridged from an article by Dr. Hermann Fol of the University of Geneva, in *La Nature*.

tissues of such animals are the most perfect filters known, neither permitting the entrance, nor tolerating the existence, of any foreign material, unless the tissues are diseased.

3. Sufficiently prolonged exposure to a temperature of at least 110° C. This is the lowest necessary for the destruction of spores, although 80° C. is sufficient to kill bacteria in the growing condition. The length of the exposure must not be less than an hour: the longer the time beyond this, the greater the security.

4. Intermittent heating, invented by Tyndall, and much used in Germany. This consists in making the spores germinate, in order to kill the full-grown bacteria at 80° C. For this purpose, the vessels containing the fluid to be sterilized are kept at 20°–30° C. to favor the growth of the spores, and are every day raised to 80° C. for one hour, to destroy such bacteria as have become fully developed. This method takes much time, and its results are always uncertain. [This is the French point of view, but must not be accepted as that of the best authorities. — ED.]

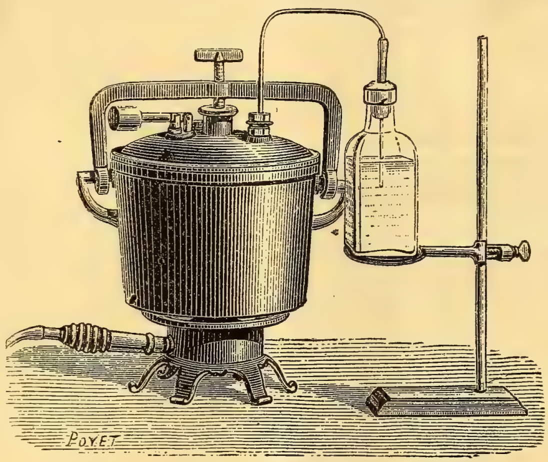


FIG. 1. — PAPIN'S POT, WITH THREE OPENINGS.

Of all these methods, the third, that of destroying the germs once for all, is the one giving the greatest security and ease of manipulation. It has but one fault, that of coagulating all albuminous substances which can be solidified at the temperature of boiling water. [This fault is a very great one, and at once excludes the use of blood-serum as a culture-medium. — ED.]

The latest and best method for employing this process is as follows: The first thing is to close the vessels meant to contain the sterilized liquids with stoppers permeable to air. The method of doing this will be described later. The flasks are then kept at a temperature of 160° C. for at least three hours. If the temperature be higher, sterilization will occur sooner, but the cotton stoppers will be charred. The furnace in which this sterilization is done should be double-walled, but its form is unimportant. The flasks should be allowed to cool slowly to prevent breakage; and, as the rarefied air contracts, the air which enters is well filtered by the cotton plug.

The second step consists in preparing the sterilized liquid, and introducing it into the flasks. The *bouillon* of Miguel is the best we know of, and is this: Take of lean meat (beef) one kilogram, and boil it in four litres of water for five hours; skim it, and let it stand over night in a cool place; then take off the fat, and neutralize the fluid with caustic soda; filter, put in water up to four litres, and boil for ten minutes.

Prolong this second boiling to an hour, and do it in a Papin's pot, at 110° C., after putting in forty grams of common salt. Then the liquid, cooled, and passed through a double filter, is again placed in the Papin's pot for three hours, which completes the sterilization. Instead of this natural *bouillon*, the following may be used: —

	Grams.
Peptone (chemically pure)	5
Basic phosph. soda	10
Ammon. muriat.	5
Liebig's extract	5
Cane-sugar	20
Cooking-salt	3
Water	1,000

Boil, filter, and sterilize as above. The result depends upon the quality of the peptone. If a nutrient gelatine be desired, put from twenty-five to thirty grams of pure colorless gelatine into either of the above fluids before the last filtering. This last should then be done through a hot filter. The other manipulations are the same, except that the sterilization must not be prolonged more than an hour; for, if it is, the gelatine loses its power of solidifying. Agar-agar may be used instead of gelatine, and remains solid at 30° C. It is only partially dissolved in boiling water, but is completely so at the end of an hour at 110° C. in Papin's pot. Filter hot, and again sterilize at 100°

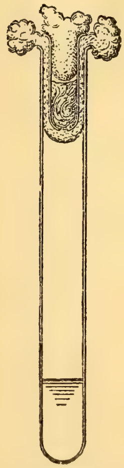


FIG. 2. — PRESERVATION TUBE.

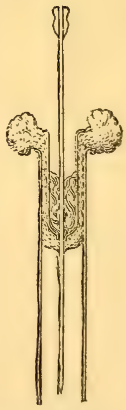


FIG. 3. — STOPPER OF PRESERVATION TUBE, WITH TROCAR POINT.

—120° C. Agar-agar will stand any amount of prolonged heat.

The pot in which the sterilization is done has three openings (fig. 1). One is for the safety-valve; the second, for the thermometer, has a tube closed at the bottom to prevent pressure upon this instrument; and the third is conical, closed with a cork kept in place by a handle and thumb-screw. A metallic tube,

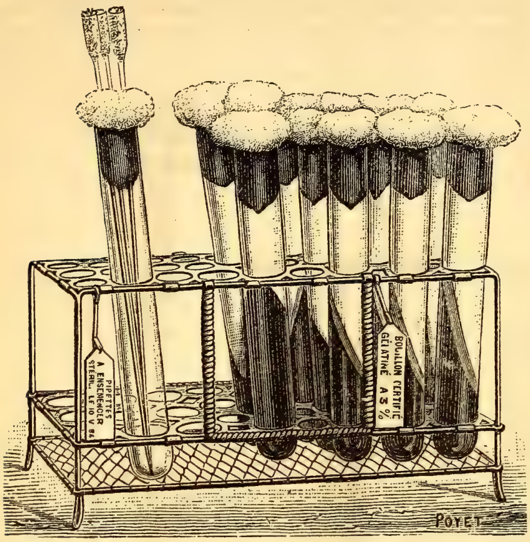


FIG. 4.—RACK FOR PRESERVATION TUBES.

bent twice, passes into the chamber. The free end is connected by rubber tubing, kept closed by a spring, to a short metal tube with a trocar point, and an opening near the extremity in the side.

After the fluid has been sufficiently sterilized, upon introducing the bent tube into the upper part of the chamber, and opening the spring, the vapor is forced out. Allow it to run for a few moments, heat the trocar end of the tube, work this through the cotton stopper of a sterilized flask, and the nutrient fluid will be gradually passed over into the flask.

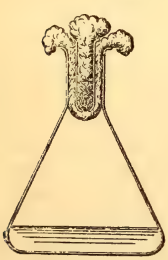


FIG. 5. — CONICAL CULTURE-FLASK.

To obviate the difficulties in the way of piercing the ordinary cotton plug with safety, small test-tubes with a flaring mouth, and a hole in the bottom, are placed in the mouths of the flasks, with cotton outside and flax at their bottoms. Above the flax is a plug of cotton (fig. 2). The trocar point can be easily forced through the flax and the thin layer of cotton underneath, if the upper plug be removed (fig. 3); and this method seems to offer the easiest and most certain manner of filling the flasks or other vessels. For cultures, I prefer test-tubes placed in racks of iron wire (fig. 4), or conical flasks with flat bottoms (fig. 5).

Accidental contamination is the one thing to be avoided in these proceedings, which is attained by heating every thing used for sowing, etc., to 300° C.; the objection to this being the difficulty of getting the instruments cool enough not to destroy the germs which we wish to use, and at the same time not cool enough to take in impurities. Manual dexterity teaches much, but more vigorous measures are better still.

I first sterilize all my instruments in test-tubes with flax stoppers, through which they pass. Such are glass pipettes, pointed, with an opening at the

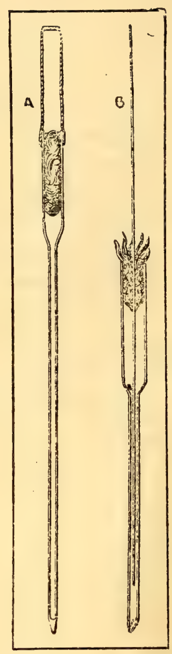


FIG. 6. — PIPETTE AND PLATINUM NEEDLE.

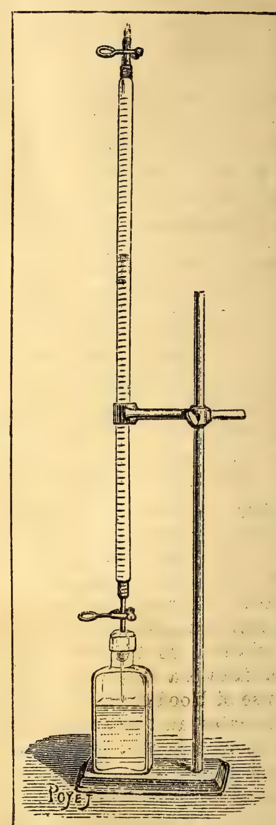


FIG. 7.—GRADUATED BURETTE.

side, and plugged at the other end with cotton-wool or flax (fig. 6, *A*). When in use, this end has a rubber cup over it, by means of which the fluid may be drawn up or expelled. For more solid materials, I use knitting-needles, or platinum wire in straight tubes with open bevelled ends (fig. 6, *B*), and, for sowing, push the point of the needle through the open end of the tube. In transferring a pure culture from one flask to another, these means are sufficient; but, with mixed cultures, separation of the various forms must be accomplished, which may be done by culture fluids or nutrient gelatine.

For fractional cultures in liquids, the principal

instrument needed is a round burette, tapering at both ends, and graduated so that the mark 100 is exactly at the lower orifice, and the mark 0 a few centimetres below the upper (fig. 7). On each extremity is placed a rubber tube closed by a spring. Before using, I disinfect the apparatus by passing sulphurous acid through it, and then attaching it to a Papin's pot filled with water at 110° C. for an hour. In fifteen minutes all trace of the sulphurous acid has disappeared, both rubber tubes are closed, their ends plugged with sterilized flax, and the burette left to cool. In cooling, a perfect vacuum is produced in the tube. I affix to the lower rubber tube a pointed canula, sterilized *at the time* by a current of steam or the flame, introduce it into a flask of *bouillon* kept for three or four weeks at 30° C. (to prove its complete sterilization), open the lower spring, and the burette is filled immediately: the fluid is allowed to rest at the mark 0.

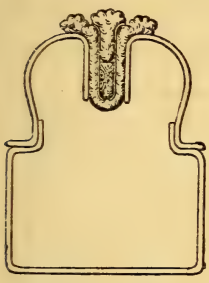


FIG. 8. — GLASS CULTURE-FLASK.

The apparatus being thus prepared, a very dilute portion of the fluid, or a small piece of the substance containing the organisms to be separated, is introduced at the top of the burette. The dilution must be great; for the contents of the burette can only be distributed among twenty-five tubes, and more than two-thirds of these tubes must become inoculated in order to the success of the experiment. If it be desired to determine the number of germs in a given specimen of water, put a very minute quantity into the burette filled with sterilized *bouillon;* mix the two thoroughly, thus obtaining an equal distribution of the germs; introduce the canula of the burette, immediately after heating, through the plug of a sterilized tube; allow four cubic centimetres of the fluid to flow from the burette; and so on for twenty-five tubes.

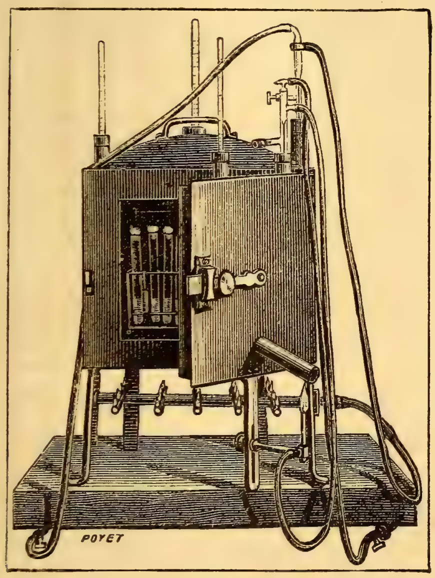


FIG. 9. — WIESNEGG STOVE.

If all the tubes become cloudy, it is because the amount of water used was too great; and this amount must be reduced until only a portion of the tubes show any sign of life. With water full of bacteria, the quantity to be used is too small for exact measurement; and then two burettes are used, the one full of water, and the other of *bouillon.* A drop of the suspected water is placed in the first, and then this dilution is used with the *bouillon,* as before. A simple arithmetical calculation then gives the approximate number of germs in a given quantity of water.

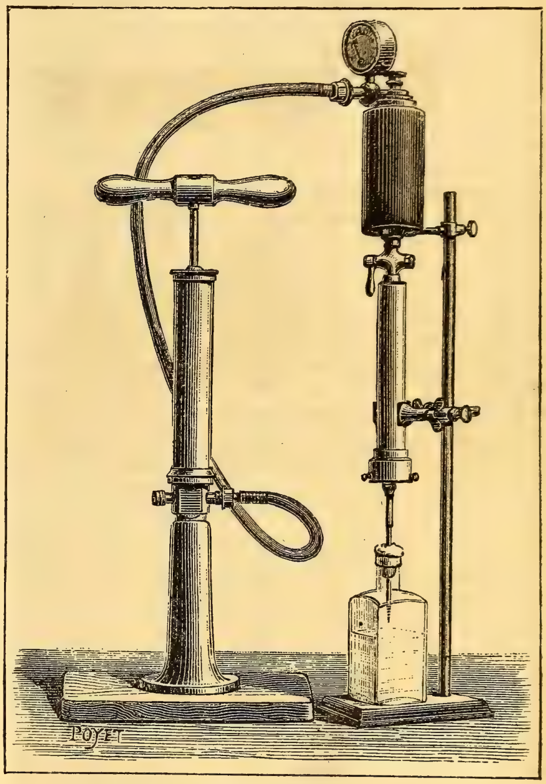


FIG. 10. — CHAMBERLAND'S FILTER.

The first experiments of Pasteur and Tyndall were imperfect in method; Miguel used a flock of cotton in a glass tube, through which he filtered the air, and then washed the cotton in sterilized *bouillon:* my improvement is to substitute a powder, soluble in the nutrient fluid, for the cotton; and for this purpose I use common salt, well sterilized. This salt may be turned into the burette, and the calculation made as before.

The results obtained by fractional culture are at the

best but approximate; but even these are better than the results from cultures scattered over gelatine surfaces. This method, however, is good as a preliminary, and is in brief as follows: A definite quantity of the suspected water is placed in a measure of nutrient gelatine; this is softened by heat, and the two are thoroughly mixed; and the gelatine is then allowed to harden in a test-tube, or in such a flask as is shown in the figure (fig. 8). The flat, thin surface thus obtained makes it more easy to count the colonies which will appear in a few days. For air-germs, the soluble powder spoken of above is the material to be placed in the nutrient gelatine.

The objections to the method are, that many species of bacteria develop very slowly at the temperature of the air and in a solid medium, and are obscured by other more rapidly growing colonies. The same objections hold in separating the germs in any pathological process.

The method of fractional sterilization used by the Germans is only useful where egg-albumen, or other substances coagulable by heat, are to be employed for culture-media. For this purpose I use a furnace (fig. 9) designed by myself, and manufactured for me by Mr. Wiesnegg. It serves its purpose well, and is much better than that of Koch. It is of double-walled copper, the intervening space being filled with water. This space has openings for thermometer and regulator. The door is double-walled, filled with water, and has its special heater, and it is kept at exactly 75° C. Tubes containing the material to be sterilized are placed in this furnace for one hour daily to kill the full-grown bacteria, and during the rest of the time are kept at 35° C. to favor the growth of the spores. In ten or twelve days the greater part of the tubes will be found to be fully sterilized.

Far better than this is the method of filtering through a substance sufficiently fine to retain all germs, successful results having been long obtained by Pasteur by filtering through plaster. Chamberland's method through porcelain is, however, the best (fig. 10), and is perfectly satisfactory provided the porcelain tube is good. This latter is difficult to obtain. Diluted egg-albumen and blood-serum may be easily filtered in this way, although slowly, under a pressure of from two to three atmospheres. Great care must, of course, be taken, to prevent the contamination of the material after it leaves the canula.

This method of sterilization is peculiarly appropriate for certain animal fluids whose chemical composition is changed by heat, but which it may be necessary to employ as culture-media for certain forms of bacteria.

TRANSPORTATION OF PETROLEUM TO THE SEABOARD.[1]

THE interest in the late project for forcing water for army purposes over the broken and elevated country between Suakin and Berber by means of pipes has called attention to the extent, importance, and utility of the pipe-lines in our own country, which convey the crude petroleum of the region lying between the Alleghanies and Lake Erie to the shores of that lake and the Atlantic seaboard.

The exploitation of these regions by means of artesian wells began about twenty-six years ago. By June, 1862, 495 wells had been sunk near Titusville, and the daily output was nearly 6,000 barrels, selling at the wells at from $4 to $6 a barrel. But as the production increased with rapid strides, the market-price fell with a corresponding rapidity, making the transportation charges to New-York City a considerable proportion of the total cost.

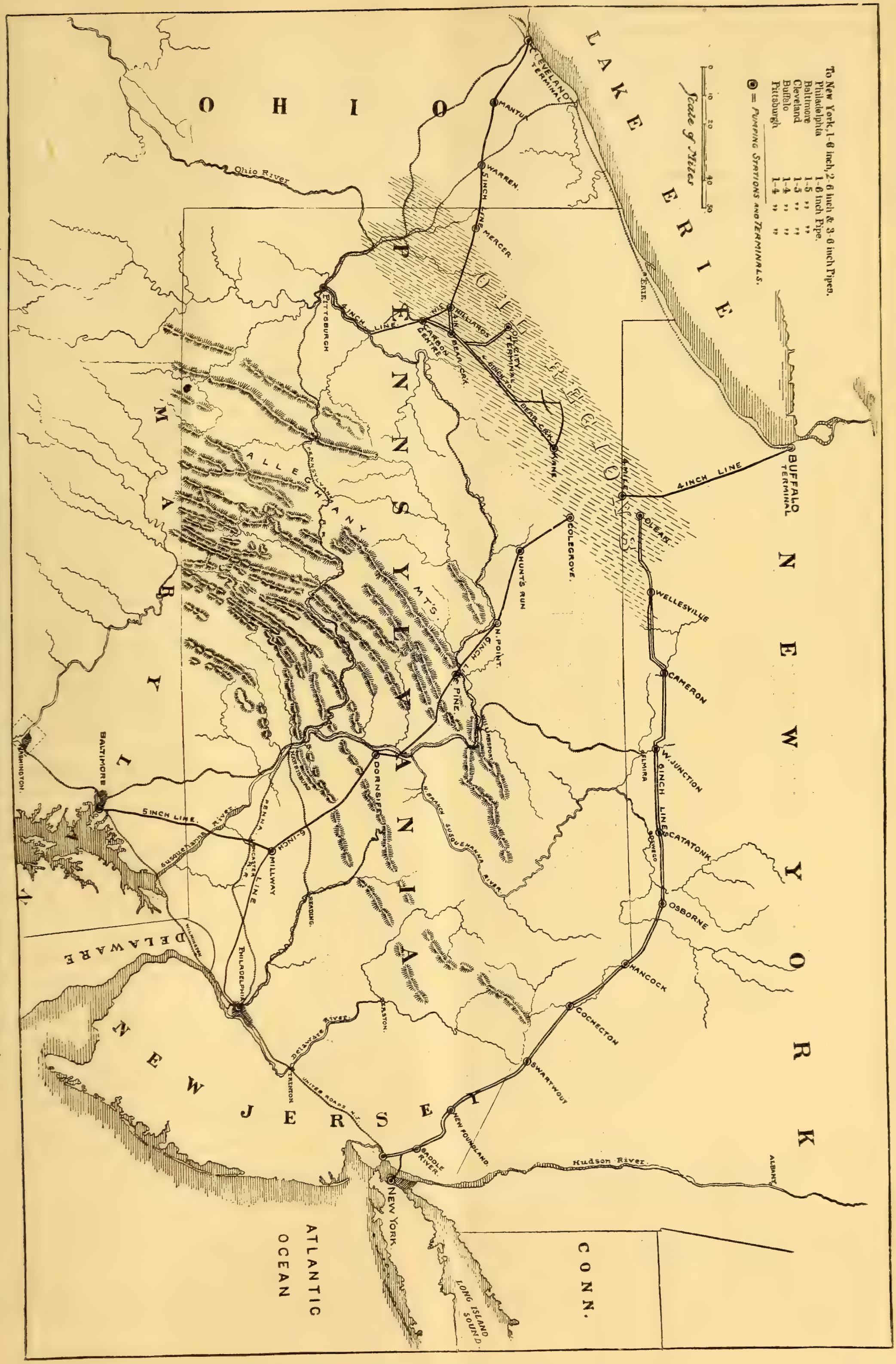
The question of reducing these enormous transportation charges was first broached, apparently, in 1864, when a writer in the *North American* of Philadelphia outlined a scheme for laying a pipe-line down the Allegheny River to Pittsburgh.

Originally the oil was carried in 40 and 42 gallon barrels, made of oak, and hooped with iron: afterward tank-cars were introduced. These were at first ordinary flat cars, upon which were placed two wooden tanks, shaped like tubs, each holding about 2,000 gallons. On the rivers, bulk-barges were also, after a time, introduced on the Ohio and Allegheny. At first these were rude affairs, and often of inadequate strength; but, as now built, they are 130 by 22 by 16 feet in their general dimensions, and divided into eight compartments, with water-tight bulkheads. They hold about 2,200 barrels. In 1871 iron tank-cars superseded those of wood, with tanks of varying sizes, ranging from 3,856 to 5,000 gallons each. These tanks were cylinders 24 feet 6 inches long and 66 inches in diameter, and weighed about 4,500 pounds.

Among the very first, if not the first, pipe-lines laid, was one put down between the Sherman well and the railway terminus on the Miller farm. It was about 3 miles long, and designed by a Mr. Hutchinson: he had an exaggerated idea of the pressure to be exercised, and at intervals of 50 to 100 feet he set up air-chambers 10 inches in diameter. The weak point in this line, however, proved to be the joints. The pipes were of cast-iron; and the joint leakage was so great, that little if any oil ever reached the end of the line, and the scheme was abandoned in despair.

In October, 1865, the Oil transportation company completed and tested a pipe-line 32,000 feet long. Three pumps were used upon it, — two at Pithole, and one at Little Pithole. The first plans to extend such lines to the seaboard seem to have been made in 1876, when the pipe-line owners held a meeting to organize a pipe-line company for this purpose; but the scheme was never carried out. In January, 1878, the Producers' union organized for a similar seaboard line, and laid pipes; but they never reached the sea, stopping their line at Tamanend, Penn. About four years ago the National transit company was organized, and succeeded to the properties of the American transit company. Its lines, illustrated on the accompanying map, were completed in 1880–

[1] Abstract of an article in the *Engineering news* of last week, from advance sheets furnished by the courtesy of the editor.



MAP SHOWING PIPE-LINES OF THE NATIONAL TRANSIT COMPANY. (*Engineering news.*)

81; and this company, to which the United pipe-lines have also been transferred, is said to have $15,000,000 invested in plant for the transport of oil to tide water. They operate a total of 880 miles of main pipe-line alone, ranging from 4 inches to 6 inches in diameter; or, adding the duplicate pipes on the Olean New-York line, we have a round total of 1,330 miles, not including loops and shorter branches, and the immense network of the pipes in the oil regions proper.

A general description of the longest line will practically suffice for all, as they differ only in diameter of pipe used, and power of the pumping-plant. As shown on the map, this long line starts at Olean, near the southern boundary of New-York state, and proceeds by the route indicated to tide water at Bayonne, N.J., and by a branch under the North and East River, and across the upper end of New-York City to the Long-Island refineries. This last-named pipe is of unusual strength, and passes through Central Park. The following table gives the various pumping-stations on this Olean New-York line, and some data relating to distances between stations and elevations overcome: —

Pumping-stations.	Miles between stations.	Elevation above tide.	Greatest summit between stations.
		Feet.	Feet.
Olean	–	1,490	–
Wellsville	28.20	1,510	2,490
Cameron	27.91	1,042	2,530
West Junction	29.70	911	1,917
Catatonk	27.37	869	1,768
Osborne	27.99	1,092	1,539
Hancock	29.86	922	1,873
Cohecton	26.22	748	1,854
Swartwout	28.94	475	1,478
Newfoundland	29.00	768	1,405
Saddle River	28.77	35	398

On this line two 6-inch pipes are laid the entire length, and a third 6-inch pipe runs between Wellsville and Cameron, and about halfway between each of the other stations, 'looped' around them. The pipe used for the transportation of oil is especially manufactured of wrought-iron to withstand the great strain to which it will be subjected. The pipe is made in lengths of 18 feet, and these pieces are connected by threaded ends and strong sleeves. The pipe-thread and sleeves used on the ordinary steam and water pipe are not strong enough for the duty demanded of the oil-pipe. Up to 1877, the largest pipe used on the oil-lines was 4-inch, with the usual steam thread; but the joints leaked under the pressure, 1,200 pounds to the square inch being the maximum the pipe would stand. This trouble has been remedied by the pipe of the present day, which is tested at the mill to 1,500 pounds' pressure, while the average duty required is 1,200 pounds. As the iron used in the manufacture of this line-pipe will average a tensile test strain of 55,000 pounds per square inch, the safety factor is about one-sixth.

The line-pipe is laid between the stations in the ordinary manner, excepting that great care is exercised in perfecting the joints. No expansion joints or other special appliances of like nature are used on the line, so far as we can learn; the variations in temperature being compensated for, in exposed locations, by laying the pipe in long horizontal curves. The usual depth below the surface is about 3 feet, though in some portions of the route the pipe lies for miles exposed directly upon the surface. As the oil pumped is crude oil, and this, as it comes from the wells, carries with it a considerable proportion of brine, freezing in the pipes is not to be apprehended. The oil, however, does thicken in very cold weather, and the temperature has a considerable influence on the delivery.

A very ingenious patented device is used for cleaning out the pipes, and by it the delivery is said to have been increased in certain localities fifty per cent. This is a stem about 2½ feet long, having at its front end a diaphragm made of wings which can fold on each other, and thus enable it to pass an obstruction it cannot remove. This machine carries a set of steel scrapers somewhat like those used in cleaning boilers. The device is put into the pipe, and propelled by the pressure transmitted from the pumps from one station to another. Relays of men follow the scraper by the noise it makes as it goes through the pipe, one party taking up the pursuit as the other is exhausted. They must never let it get out of their hearing, for, if it stops unnoticed, its location can only again be established by cutting the pipe.

At each station are two iron tanks 90 feet in diameter and 30 feet high. Into these tanks the oil is delivered from the preceding station, and from them the oil is pumped into the tanks at the next station beyond. The pipe system at each station is simple, and by means of the 'loop-lines' before mentioned, the oil can be pumped directly around any station if occasion should require it.

The engines vary in power from 200 to 800 horse-power, according to duty required. They are in continuous use, day and night, and are required to deliver about 15,000 barrels of crude oil per 24 hours, under a pressure equivalent to an elevation of 3,500 feet.

The enterprise has been so far a great engineering success, and the oil delivery is stated on good authority to be within two per cent of the theoretical capacity of the pipes. From a commercial stand-point, the ultimate future of the undertaking will be determined by the lasting qualities of wrought-iron pipe buried in the ground, and subjected to enormous strain. Time alone can answer this question.

THE STUDY OF BACTERIA.

THIS is the best summary of the methods best adapted for bacterial research that has as yet been published. It contains little that is

Die methoden der bakterien-forschung. Von Dr. FERDINAND HUEPPE. Wiesbaden, *Kreidel*, 1885. 8+174 p., illustr. 8°.

not necessary; and yet, with this book in hand, the beginner may feel sure of not going astray, if he follows the directions laid down in it.

The book opens with a brief statement of the various classes of bacteria, which is followed by a consideration of the theory of spontaneous generation, and the principles upon which sterilization depends. These latter are very well and briefly stated. The various methods of sterilization are spoken of and explained, and due prominence is given to the method of 'discontinuous' or 'intermittent' sterilization so much used at present.

The second chapter is devoted to the various forms of bacteria, and to an elucidation of the microscopic technique. The method of observation of unstained and stained bacteria is fully shown, and the general principles of the aniline colors are explained. Here are brought together, in a convenient form, all the various staining-fluids of Koch, Ehrlich, etc., with their formulae. The various accessories in the way of reagents and instruments, are, of course, included.

The importance of the bacillus of tuberculosis in furnishing a conclusive method for the diagnosis of this disease leads the author to devote a number of pages to the methods of staining this organism; and all workers in this branch of investigation will be glad to find the full account of the methods of staining *spores* which is given. The method of treating sections of the tissues for purposes of showing bacteria contained in them closes this portion of the work. The various culture methods and materials are clearly given; and the formulae for the various nutritive media, are, of course, added. The advantages of the solid over the fluid cultures are so manifest as to need but a very few words; but these advantages are here so clearly set forth, that any sceptic may be convinced if he will but read the evidence.

Something is said of the saprophytic and parasitic bacteria, and a summary of the general biological problems involved is given.

The book closes with a few words on the special investigation of earth, air, and water.

All the more important implements needed are figured in very good woodcuts, and there are two lithographic plates showing various culture colonies and stained bacteria.

The work is a good one, and well done. It is especially needed at the present time of interest in all that belongs to bacteriological research, and will certainly prove useful to any one interested in the subject who is able to translate easy German.

SAPORTA'S PROBLEMATICAL ORGANISMS OF THE ANCIENT SEAS.

Fossil algae are proverbially difficult and unsatisfactory subjects for study. Usually of irregular and variable forms, without definite and characteristic surface-markings, and composed only of cellular tissue which has entirely disappeared, they have left shadowy outlines, or mere casts, that afford only the most general and superficial characters for comparison among themselves or with living plants: hence there must be considerable uncertainty in regard to the botanical relations of even those best preserved; while those which are more obscure are liable to be, and have been, confounded with tracings made by floating objects, the tracks or burrows of annelids, with sponges, alcyonarians, medusae, and other soft-bodied and perishable organisms. Yet the supposed remains of seaweeds are so abundant in rocks of all ages, from the Cambrian up, that they could not be ignored; and a large number of more or less distinct imprints, some of which are unmistakable algae, have been figured and described by Sternberg, Brongniart, and other writers on fossil botany who have followed them. Count Saporta is one of the latest and most learned of these writers, and one who has done much excellent work in his studies of the mesozoic and tertiary plants of France. In his valuable and voluminous contributions to the 'Palaeontologie Française,' and in his 'L'évolution du règne végétal,' he has given a large number of figures and descriptions of what he supposed to be fossil seaweeds, and has attempted a more thorough review of this department of fossil botany than any one else has ventured on. As to the character of much of his material, there can be no reasonable doubt; but some of his specimens are too obscure to warrant any very positive assertions, and in some cases his conclusions have been questioned.

A somewhat sweeping criticism of Saporta's work was recently made by Mr. A. G. Nathorst (*Bull. de la soc. géol. de France*, 3 sér. t. xi. p. 452), who considers that most of his so-called algae are simply casts of tracks or other impressions mechanically made on the sea-bottom.

The work now published is largely a defence of the views heretofore held by Saporta, and it contains figures and descriptions of a number of the casts and impressions which have been the subjects of controversy. Among other things noticed are those peculiar and enigmat-

Les organismes problématiques des anciennes mers. Par le Marquis de Saporta. Paris, 1884. 4°.

ical objects which have been found in all countries, and have been described under the names of Cruziana, Rusophycus, etc. These are usually casts of impressions in what was the slimy surface of a mud sheet, sometimes an inch, sometimes a foot or more, in length, by from one to two inches in width. A deep sulcus traverses the middle, and the surface is marked by divergent and parallel, or curiously reticulated and inosculating ridges.

First noticed by Dr. Locke in Ohio in 1838, and named by Vanuxem in 1842 Fucoides biloba, by D'Orbigny in 1842 Cruziana, by Rouault in 1850 Fraena, and by Hall in 1852 Rusophycus, they have been since referred to under one or another of these names by most writers on geology. By the authors mentioned they were regarded as the impressions of seaweeds; but by Dawson, Lapparent, Briart, Hebert, Hughes, Nathorst, and J. F. James they have been considered the tracks of animals. Saporta, in the work under consideration, discusses their character and origin at great length. He pronounces them fucoids, and calls them Bilobites, taking the name from De Kay, and referring for authority to the first volume of the 'Annals of the New-York lyceum of natural history' (1824), where a paper is published by De Kay, "On the organic remains termed 'Bilobites' from the Catskill Mountains," illustrated with one plate and four figures.

On referring to this paper, every American geologist will at once recognize in the fossil described, Conocardium trigonale, a characteristic mollusk of the corniferous limestone and the Schoharie grit. When the suture of this shell is exposed, the carinated valves present an appearance which led our earlier geologists to regard it as a crustacean allied to the trilobite, but distinguished by having two lobes instead of three. De Kay, though retaining the term 'Bilobites,' recognized its molluscous character, and its resemblance to Cardium. From these facts it will be seen that Bilobites of De Kay has no relation whatever to Fucoides biloba of Vanuxem, or Cruziana of D'Orbigny, and the name has been erroneously applied by Saporta. The descriptions of Vanuxem and D'Orbigny bear the same date; but, the old genus Fucoides having been broken up and abandoned, D'Orbigny's Cruziana would seem to be the proper name for these singular objects. Hall's name, Rusophycus (called Rysophycus by Hughes as being more correct), is apparently a synonyme of Cruziana, and, published later, must be superseded by that.

Though we have thus obtained a name for these objects, their true character is as far from being demonstrated as ever, nor does it seem probable that the present diversity of opinion will soon be harmonized. Every one who has seen much of the exposures of shallow-water sediments, shales, and flagstones, will concede that many of the so-called fucoidal markings are of mechanical origin, and will accept Nathorst's view that such casts as Eophyton and Panescorsea are inorganic. Where the cast consists of a number of divergent ridges springing from a common stem like branches from a trunk, such as Vexillum Sap. (which, however, can hardly be distinguished from Licrophycus of Billings), the conclusion seems inevitable that the cast is organic, and the form is rather that of a plant than a sponge.

Although so far resulting in little demonstration, the discussion in which Saporta and Nathorst have taken the leading parts has excited much interest, and has been productive of an important series of experiments and observations. Doubtless in this, as in many other discussions, the truth will be found to lie between the views of the opposing leaders, yet science will be advanced by the stimulus to inquiry furnished by these very differences.

J. S. NEWBERRY.

PRONUNCIATION.

MEETING a book of this kind, admitting its possible utility, one naturally asks whether the pronunciations recommended are correct, with allowance for admissible variations, whether the description and representation of sounds are exact and clear, and whether the list of words likely to be mispronounced is judiciously made. The first and last of these questions suggest no severe criticism of this book, unless one considers only matters of detail. We mention only one. Paragraph 51, in the introduction, should be changed so as to make it clear that by 'antepenultimate vowel' is meant that in the Latin words referred to, not in the English, as is now absurdly said.

The second question shows the weakness and unpractical plan of the book. Passing by the introduction, which shows some careful observation, but has several hazardous assertions, we come to the body of the book. Here each page contains two columns, — on the right hand, the words in alphabetical order, but

A handbook of pronunciation. By LEWIS SHERMAN. Milwaukie, *Cramer, Aikens, & Cramer, pr.*, 1885. 174 p., illustr. 8°.

not perfectly so (witness *consols*) ; on the left hand, the same words, in the same spelling, but with various devices to show the pronunciation, such as the use of accents, acute and grave, heavy type for some letters, and smaller type for silent letters. The notation used is a new one, and the final result far from being readily intelligible. The proper course would have been to minimize the inconvenience to the user by making the left-hand column as simple as possible, using always only one sign for the same sound, and omitting silent letters altogether. If all the words are respelled solely to show their pronunciation, there is no excuse for not spelling phonetically.

NOTES AND NEWS.

THE local committee of the American association, which will hold its thirty-fourth meeting in Ann Arbor during the week beginning Wednesday, Aug. 26, announces that the general sessions will be held in University Hall, while rooms for the sectional meetings will be assigned in different buildings on the university grounds. The offices of the permanent and local secretaries and of the various committees will be established in the immediate proximity, together with an association post-office; and all letters, telegrams, and express packages bearing the letters 'A. A. A. S.' will be delivered close at hand. The university offers the use of its rooms for any lectures, or specially illustrated papers, which may be authorized by the standing committee. Sectional papers demanding experimental illustration may be supplemented by the use of the apparatus at hand. The university will furnish electricity, either from a dynamo, from a storage-battery, or from primary batteries, as may be needed by members reading papers on electrical subjects. Opportunity will also be given any member desirous of making an exhibit of apparatus, minerals, or scientific specimens of any kind, to properly display the same.

The committee is not yet ready to announce complete arrangements with the railways, but they state provisionally that over most of the lines return tickets will be furnished for one-third of the regular price to all who have paid full fare over the same line. Ann Arbor is situated on the lines of two railways, — the Michigan central, and the Toledo, Ann Arbor, and northern Michigan; and a special through train, for the exclusive use of members of the association, will be run by the former if a sufficient number desire, leaving Buffalo on Tuesday morning, Aug. 25, stopping for an hour or two at Niagara Falls, and reaching Ann Arbor in the evening of the same day. The two hotels at Ann Arbor are the Cook House and the Franklin House, where members will be accommodated at two dollars a day. A large number of rooms, with prices varying from fifty cents to a dollar a day, have also been engaged in private houses near the university grounds, where, to accommodate those not offering board as well, a restaurant sufficient to accommodate three hundred persons at once will be established, at which, breakfast, dinner, and supper will be furnished at the uniform price of fifty cents. Private hospitality is also liberally promised by many citizens; and there is no question of sufficiency of accommodation, as most of the two thousand students who live in the city during term time will be absent on their vacation.

An evening reception on a day not specified will be given the association at the court-house, together with a lawn-party on the university grounds at the close of one of the regular sessions. The excursions committee has nearly completed arrangements for a trip, free of all expense, to the Saginaw valley, including a steamboat ride down the river, and view of the cities of Saginaw, East Saginaw, Bay City, and West Bay City, and the enormous industries in salt and lumber manufacture which have given the Saginaw valley a world-wide celebrity. This valley produces annually a billion feet of lumber, and the excursionists will see half a billion piled on the docks. In conjunction with these vast lumber operations will be seen the production of salt on a scale unequalled in the world, and employing the various improved processes. The committee has also arranged for excursions to Detroit and Mackinack Island, with side trips to Sault Ste. Marie, Pectoskey, and Marquette. Members wishing to make any special inquiries or arrangements should address Prof. J. W. Langley, local secretary, Ann Arbor, Mich.

— Matusoffski and Nikitine, well known for their travels in China and Sakhalin, have recently finished a new map of China; that is to say, of the Middle Kingdom, with the region bordering upon it. This chart is on the scale 1:4,200,000, and is the best yet issued in point of execution. Paderin, Uspenski, and Sheveleff have served as a committee on the orthography of proper names, with Professor Vasilieff as umpire in doubtful cases. It extends from the western borders of Corea to the Yung-ling Mountains, and between latitudes 16° and 45° north.

— The *Annuaire de Turkestan* for 1885 has just been issued by Messrs. Sokoloff and Lakhtin. Its contents are of unusual interest in connection with recent events, and comprise, among other things, a chronology of historical events from 1155 to 1884; a memoir on the Merv oasis and on the route between Khiva and the Caspian; notes on the Amu Daria; a description of Ferghana, of the museum at Tashkent, of the fisheries of Turkestan, and an account of public instruction in Turkestan.

— A special chair of geology has just been established in the Indiana university, and Prof. J. C. Branner of the Geological survey of Pennsylvania has been chosen to fill it. Professor Branner was for six years assistant geologist to the Imperial geological survey of Brazil. Prof. J. P. Naylor of Indianapolis has been elected to the chair of physics.

— Dr. Hermann Roskoschny has projected a series of geographical manuals on European and especially German colonization, under the title 'Europas kolo-

nien.' Under the same editor has just been issued the first part of a hand-lexicon of Africa by Paul Heichen, to comprise thirty parts, octavo, at fifty pfennige each, to be profusely illustrated, and to contain retrospective as well as actual information. It is well printed, and is published by Grossner & Schramm, Leipzig.

— A long-delayed letter from the bishop of central Oceanica gives details of the honors rendered by the civil and religious authorities to the relics of the companions of La Perouse. These last survivors of that unfortunate expedition were massacred by the Samoans on the Islet of Tutuila on the 11th of December, 1787. Father Vidal, of the mission, had been searching twelve years for the remains, which were finally identified in October, 1882. The authorities in France, on being notified, caused a beautiful mortuary tablet to be prepared, and forwarded to the admiral on duty at that station. A monument was erected, upon which the tablet was fixed, and a small chapel built near it. The whole was dedicated by Bishop Lamaze and Commandant Fournier, of the French navy, with solemn ceremonial and minute-guns on the ninety-seventh anniversary of the event.

— The Société de géographie has elected Mr. de Lesseps, the present incumbent, to its presidency for 1885–86, and Messrs. Himly and Bischoffsheim, vice-presidents.

— A portion of the work of Protestant missionaries in China, which has attracted little attention, says *Nature*, and which, nevertheless, is of great importance, is the preparation of school and text books in Chinese. For this purpose Protestant missionaries of all nationalities and denominations have united. At a general conference held in Shanghai in 1877, a committee of eight of the leading missionaries was appointed to superintend the preparation and publication of the series. The work has now been going on for eight years, and the committee are able to report that over forty works have been issued, and that thirty more are in various stages of progress. In addition, four numbers have been issued of an 'outline series' compiled with the object of supplying Chinese schools with small and simple treatises on scientific subjects at cheap rates, suitable either as elementary school-books or as popular tracts for general distribution. What 'cheap rates' mean, will appear from the fact that the outlines of astronomy costs rather less than a penny; those of political and physical geography and geology, about twopence each. The larger works embrace anatomy in five volumes, ancient religions and philosophies in three, arithmetic, charts of astronomy, birds and mammals, with accompanying handbooks (these charts, from the prices, are obviously intended for the walls of schools), chemistry, political economy, geology, universal history, international law (a translation of Bluntschli, it appears), zoölogy, and several on biblical topics. Those in preparation include treatises on various branches of elementary mathematics, botany, ethnology, hygiene, jurisprudence, logic, mathematical physics, meteorology, mineralogy, philology, and forty wall-charts with accompanying handbooks. These works, it must be remembered, have first to be compiled with a special view to the knowledge usually possessed by Chinese children, and then to be translated, representing in each case two distinct tasks. That the missionaries in China and elsewhere have schools where they teach the young, is well known; but it will probably be a surprise to many to find, that, in addition to their ordinary labors as preachers and teachers, the missionaries in China have had to undertake a task of such magnitude as the creation of school literature on all subjects of human knowledge, from arithmetic to jurisprudence, and from anatomy to logic. The statement on this subject is taken, it should be added, from the *Chinese recorder* of Shanghai, a magazine which is itself a monument to the learning and enterprise of Protestant missionaries in China.

— The second edition of Macfarlane's 'Geological railway guide,' first published in 1879, is now in active preparation. As its advance depends on co-operation from many state geologists and others, it is of necessity somewhat leisurely; but substantial progress is marked by thirty preliminary pages, which describe the Dominion of Canada, prepared by G. M. Dawson; and, if the rest of the work is up to this high standard of detail, it will be a great improvement on its valuable predecessor. The notes are full, and serve an excellent purpose. For example: under St. Hilaire station, Grand Trunk railway, we find, "Beloeil Mountain, one of the remarkable igneous protrusions which penetrate the flat-lying Silurian rocks of the St. Lawrence valley, may be visited from this point. The mountain is partly composed of augite syenite, and partly of nepheline syenite. An excellent summer hotel on the mountain." Again, at Thorold, "Good section of Clinton and Niagara in cutting of Welland canal. Fossils. A band of argillaceous limestone eight feet thick in the Niagara yields an excellent cement."

— The ordnance survey of the United Kingdom has issued an interesting report on the progress made to the end of 1884. Scotland and Ireland have been completed, and maps of these countries on the six-inch scale have been published. In Wales, Pembroke, Carnarvon, and Anglesea alone remain to be surveyed. It is hoped that the whole of the kingdom may be finished by the year 1890.

— Professor Hermann Fol has made a most valuable contribution to the resources of the histologist through the publication of the first part of his 'Lehrbuch der vergleichenden mikroskopischen anatomie,' — a treatise which ought to be in the hands of every morphologist and microscopist. The first part is entirely devoted to technique, and is so thorough and exhaustive, and done with so much critical acumen, that it surpasses all its predecessors. Sensible and practical directions for the use of the manifold instruments and operations of the histologist are given. The author has added also many valuable explanations and criticisms, and describes a number of new implements and methods devised by himself.

The present part contains the latest methods, and cites the literature very fully, and may be bought separately by those who wish. Part second will treat of the cell and the structure of unicellular animals; part third, of the ectoderm and its derivatives in the metazoa; part fourth, of the entodermal and mesodermal organs, — the whole to make a volume of some six hundred and fifty pages.

— According to the *Colonies and India*, Baron F. von Müller, K.C.M.G., has issued, under the auspices of the Victorian government, a second supplement to his systematic census of Australian plants. It appears from the information now published, that, whilst the known plants of Australia and Tasmania are about 9,000, they occur in the following proportions in the respective colonies: viz., western Australia, 3,455; Queensland, 3,457; New South Wales, 3,154; northern Australia, 1,829; Victoria, 1,820; South Australia, 1,816; and Tasmania, 1,023. The progress of botanical discovery in Australia within the last quarter of a century has been very marked; and the colonies are mainly indebted to Baron Müller for this result. He, with the late Mr. Bentham, prepared and published the seven volumes of the 'Flora Australiensis.'

— Dr. Fischer, who lived for seven years as a doctor in Zanzibar, has published a book on the colonization of tropical Africa, called 'More light on a dark quarter of the world;' also a report of his journey from Pangani to Lake Naewascha, undertaken for the Hamburg geographical society.

— According to *Nature*, the British consul at Leghorn, in his report for the past year, makes some interesting observations on coral in the Mediterranean. Some centuries back the Mediterranean coral fisheries were carried on exclusively by the Spaniards, and the principal establishments engaged in the manufacture of coral ornaments were in the hands of Jews residing in Spain. Towards the close of the sixteenth century, to escape the persecutions to which they were exposed, a large number of these merchants removed to Leghorn, in order to enjoy the secure asylum afforded by the liberal enactments of Ferdinando di Medici. Crews were obtained from the Neapolitan coast, principally from Torre del Greco: hence this place, at an early period, became the chief seat of the coral fishery; and most of the boats engaged in it are still fitted out at that port, although the manufacture of coral ornaments and beads is carried on principally at Leghorn and Genoa. These ornaments are met with in almost every part of the world; and in many countries, even in Europe, coral is believed to be possessed of a peculiar charm. In Asia and Africa it is regarded with a sort of religious veneration, while in India it is largely used for the adornment of corpses when prepared for cremation. But the present situation of the coral trade is disastrous. In 1880, a coral bank several kilometres in length was discovered near the island of Sciacca, on the coast of Sicily, and consequently the yield of raw material has been far in excess of the demand, and the reef is still very far from being exhausted. A great depreciation in value has ensued, and, as a consequence, an extensive trade has sprung up in coral with Africa, where the natives now purchase coral ornaments in place of glass beads of Venetian and German manufacture. The raw coral comes from Naples, and is worked at Leghorn by women into beads, British India and Egypt being the chief customers for them.

— Mr. Shelford Bidwell has read a paper before the Royal society, on the changes produced by magnetization in the length of rods of iron, steel, and nickel. He finds that the length of an iron rod is increased by magnetization up to a certain critical value of the magnetizing force; and, if that is passed, the elongation is diminished in proportion as the magnetizing force increases. The amount of the maximum elongation appears to vary inversely as the square root of the diameter of the rod. In soft steel, magnetization produces elongation; and, with hard steel, the critical value of the magnetizing force becomes very high. In soft steel a temporary elongation, once produced, may be maintained by a magnetizing force too small in itself to produce any elongation. Nickel continues to retract with magnetizing forces far exceeding those which produce the maximum elongation of iron. The greatest observed retraction of nickel is more than three times the maximum observed elongation of iron, and the limit has not yet been reached.

— Prof. H. A. Hazen has prepared a signal-service note (no. xx.) on the thunder-storms of May, 1884, in which he gives a brief statement of the results obtained from the volunteer observations on these storms, gathered on special cards from persons in all parts of the country. It is illustrated by maps for May 18 and 19, showing the advance of the thunder-storm area for these days. The conclusions presented are, 1°, hail-falls occur ordinarily with a pressure much below the normal, and in a position two or three hundred miles south-east of the centre of barometric depression (cyclonic centre); 2°, thunder-storms advance from west to east and south-east, generally accompanying a cyclonic depression in its south-east quadrant, four or five hundred miles from the centre; 3°, their action seems to die down at night, and begin again in the morning, and often spreads in a fan-shape to south-east and east; 4°, the velocity of the thunder-storm's advance is greater than that of the accompanying cyclonic depression. Description of the simple method of observation is added, and it is stated that more observers are still desired. Franked cards for mailing records will be supplied on application to the chief signal officer of the army, Washington.

— Mr. E. W. Maunder, assistant in charge of the spectroscopic work of the Royal observatory, Greenwich, is giving, in the current numbers of the *Observatory*, a paper on the motions of stars in the line of sight, as determined by spectroscopic methods. He remarks, that if the definition attributed to Bessel be a correct one, — that 'astronomy is the study of the movements of the heavenly bodies,' — spectroscopy had no claim to be regarded as a branch of astronomy,

until Dr. Huggins obtained his first measure of the displacement of the *F* line in the spectrum of Sirius, and thus proved that it was possible to ascertain the speed with which the star was moving in the direction of the visual ray,—an observation which deserves to rank in importance with the first detection of the proper motions of stars, or the first determination of their annual parallax, or even somewhat higher as being more entirely a novel enterprise.

—E. Revillout, the French Egyptologist, has nearly completed an exhaustive report on the demotic documents in the British museum which have been discovered in the course of the destruction of some Coptic houses in Lower Egypt. These demotic *ostraka* include a great number of receipts for taxes, some being of the Roman period. Revillout points out that one of the demotic *ostraka* preserved in the Louvre is composed in exactly the same formula as those written in Greek during the second year of the reign of Caligula, and the thirteenth year of Nero. Other analogous examples are among those in the British museum. The most interesting of the *ostraka* submitted to Revillout are of the Ptolemaic period, amongst which occur several bilingual texts of considerable importance. One of these decides a great question about money; and another example is a receipt, payable in corn, of a kind up to the present time only known from the Greek texts, and demonstrating the validity of theories with regard to measures hitherto held as provisional only. Other *ostraka* in the collection record oaths taken about crops, the succession of property, and accusations of thefts from the catacombs, as well as a demand for the liberation of a slave, and an instrument for the delivery of certain property, the manner being recorded in which a house was left by its owner.

—The students of the Kansas State agricultural college at Manhattan are planning a natural-history expedition during the summer in the west. The field of their operations will lie between the 100th and 150th meridians.

—The report of the proceedings of the Reale academia dei lincei, Rome, as contained in *Nature*, cites Professor Tacchini's communication on the hydrogenic protuberances of the sun, observed at the Royal observatory of the college of Rome during 1884. In continuation of his previous note to the effect that 1884 must be considered as a year in which the phenomena of the chromosphere had attained their maximum development, he presented the results of observations on two hundred and forty-two days, from which it appeared that the number of the protuberances increased from March to October. In order to get rid of the anomalies which are met with in various observations, and to obtain a curve representing the course of the phenomena in the period 1880–84, Professor Tacchini has taken as monthly means the means of three months. The corresponding curve shows three culminating points, or periods of maximum activity: viz., July, 1880; September–October, 1881; and March, 1884,—which last is the highest in the whole series. The maximum of the protuberances follows that of the sun-spots; and recent observations make it probable that the present year will be one of greater activity in the chromosphere and solar atmosphere.

—Prof. F. Jeffrey Bell will in future edit the *Zoölogical record.*

—Prof. H. L. Cohn, in his pamphlet 'Ueber den beleuchtungswerth der lampenglocken' (Wiesbaden, 1885) describes a long series of determinations of the relative values of various forms of lamp-shades. The method pursued was to measure the brightness of white paper lying on a table over which the source of artificial light was suspended at a given distance, by means of a Weber photometer. As one would anticipate, the general effect of a shade is to increase very greatly the illumination immediately under the light, and not modify it notably at an angular distance greater than forty-five degrees from this region. The last section of the pamphlet, which deals with the illumination requisite for easiest use of the eyes, is of the most general interest. Taking as a measure of the value of the illumination in this sense the number of lines which can be read from a newspaper in a minute, and as the unit of illumination that of a normal candle at a perpendicular distance of a metre from the paper, he finds that the best illumination is not less than fifty such units. Since even a fifth of this illumination is very rarely secured, except immediately under a lamp provided with a good shade, the author emphasizes the conclusion that few school-children work in a satisfactory light.

—The Swiss geologist and alpinist, Horace Bénédict de Saussure, the first to make the ascent of Mont Blanc (Aug. 3, 1787), is to have erected in his honor a statue in the village of Chamounix, from which point the ascent was made. It will be inaugurated on the centenary of his ascent. During the convention of the Alpine clubs at Chamounix year before last, the president of the section of the Jura, Vézien, called the attention of the alpinists to the fact that no statue in honor of the first of their number had yet been erected, and suggested that Chamounix was a suitable place for such a monument. This proposition was received with great applause; and, by a happy coincidence, at almost the same hour the president of the Swiss republic issued a decree authorizing the commune of Chamounix to accept a legacy of four thousand francs which had been made by a Mr. Chenal of Sallenches, according to a will drawn up as long ago as 1834. Mr. Chenal died in 1881; and the execution of his will has only now been accomplished. A committee has been formed to carry out the wishes of the legacy, which simply requires the erection of a monument in granite by some approved architect, with the inscription, 'À Monsieur Bénédict de Saussure, Chamounix reconnaissant.' This committee, which among others consists of Messrs. Daubrée of Paris, Alphonse Favre of Geneva, and the presidents of the Turin section and the Florence section of the Italian Alpine club, and the first president of the Austrian Alpine club, will endeavor to increase the sum, in order to erect a worthy monument. A subscription has been opened by the *Journal de Genève*, from which these facts are taken.

SCIENCE.

FRIDAY, JUNE 26, 1885.

COMMENT AND CRITICISM.

THE BILL TO ESTABLISH a board of registration in medicine and surgery for Massachusetts was rejected in the house of representatives, in the latter days of the session, by a very decided majority. A brief statement of the reasons for this action is interesting, inasmuch as the same body had already created a commission for the regulation of pharmacy. The law proposed, — substantially the same as that so successfully enforced in Illinois and West Virginia, — would, with a proper machinery for its execution, have been a benefit to the community. The measure did not, however, excite a very warm interest in the medical profession as a whole, was opposed in some important details by prominent members of one of the great medical societies, and at no time attracted sufficiently the attention of the public, with the exception of that loud-mouthed portion that naturally belongs to the quack and charlatan. The men who appeared in favor of legislation were those most competent to testify to the needs of it, — the honest practitioners of medicine. The ordinary legislator, therefore, looked upon the proposed law as a privilege desired by a class; and when he found that it was advocated by that class mainly, from his limited point of view, not unreasonably perhaps, voted against the measure. With the warning furnished by this year's experience, it is safe to assume that the medical profession will insist that the public, which is alone concerned, shall hereafter take the lead in any effort to procure legislation for the regulation of the practice of medicine.

THE ESTABLISHMENT of a botanic garden in Montreal may now be considered an assured fact. The organization has been completed by the formation of a corporation, from whom there is elected a board of management of five persons, one of whom is the director of the garden, in the person of Professor Penhallow. With a grant from the provincial government for preliminary work, land from the city, and the hearty good will and co-operation of the citizens, the garden will without doubt prove successful. The site chosen for the garden is on Mount Royal, and embraces about seventy-five acres of land well adapted for the purposes of both a garden and an arboretum. A large stone building, now on the grounds, will be used as the offices, library, museum, etc., and around this the plant-houses will be built.

IN ORDER THAT composite photographs may be of use as a scientific method for revealing the traits common to some group, it seems necessary that each step of the process employed should be subjected to careful experiment. The presumption is, that any change in the order in which the negatives are used in making the composite will have no perceptible effect in altering its appearance. Yet this should be a matter of actual experiment; and, should composites so obtained not be substantially identical, the conditions for such identity must be found, before we can feel much certainty that a composite exhibits the essential features of the group in question, as distinguished from such as might be termed accidental. It might happen, for instance, that undue prominence had been given to part of a group by variation in the intensity of the illumination during the printing, or other circumstances might interfere with the accuracy of the representation.

But a more serious question respecting the truth to nature, of the average expressed by the composite, is contained in the query, whether composites of a given group made by different photographers would be recognizably the same picture, and whether they differ more widely

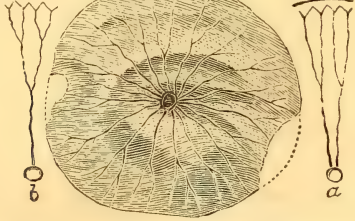
or less widely than single photographs do under similar conditions. The composites ought to be almost wholly independent of fortuitous circumstances such as this; and, although the separate negatives of the same individual might exhibit considerable deviations from each other for one reason or another, yet such deviations should have no cumulative effect in the composite, but be in effect obliterated. If, however, there is, as there well may be, some personal peculiarity in the adjustments of a photographer, his composite will necessarily bear the impress of this mannerism, and furnish a kind of personal error, which can perhaps be only eliminated by making a composite from a number of composites of the same group, each taken by a different person.

LETTERS TO THE EDITOR.

A modern type of plant in the cretaceous.

The genus Brasenia, or Hydropeltis, is represented in eastern North America by a single species, B. peltata, Pursh (Hydropeltis purpurea, Michaux), which, according to Gray, is also a native of Puget Sound, Japan, Australia, and India. A form so widely distributed may be expected to have been early introduced, so that we need not be surprised to find it occurring along with the earlier forms of exogenous life in the cretaceous of our north-west.

The specimens to which this note refers were obtained in the beds of the Belly-River series of the



BRASENIA ANTIQUA, UPPER CRETACEOUS, SOUTH SASKATCHEWAN RIVER. LEAF NAT. SIZE. *a*, *b*, DIAGRAMS OF VENATION, SLIGHTLY ENLARGED.

Canadian survey, near Medicine Hat. These beds are upper cretaceous, and hold fossils, some of which resemble those of the Laramie group, others those of the Pierre group. They contain workable beds of lignitic coal; and the specimens in question were found in nodular clay ironstone, associated with one of the coal-beds worked in the 'Lawson mine.'

A specimen of this interesting fossil, obtained, I believe, from Mr. Lawson, the manager of the mine, was kindly given to me last year by Mr. J. R. Byron, one of the members of the British association; and additional specimens, some of them very perfect, were afterwards collected by Mr. T. C. Weston of the geological survey. They resemble very closely the leaves of the modern species, differing only in their generally smaller size and somewhat less elliptical form, and slightly in the venation, the primary veins being more numerous, or about eighteen in number, while fourteen is a common number in the modern species. These differences may indicate merely a varietal form; but I have thought it best to designate the species or variety by the name B. antiqua. Associated with these leaves, in the same bed, are some other aquatics, notably Pistia corrugata (Lesqx.) and Lemna scutata (Dn), both species of the Laramie; and Platanus nobilis of Newberry (Aralia notata of Lesquereux), which, though apparently regarded in the United States as miocene, is certainly in Canada characteristically Laramie. There is also a new species of Populus — P. latidentata (Dn) — closely allied to the modern P. grandidentata, and an Acer (A. saskatchewense), whose leaves resemble small or immature leaves of A. dasycarpum. A species of Sequoia also occurs, probably S. Reichenbachii. Though all these plants have a very modern aspect, they are unquestionably cretaceous; and I have myself assisted at the disinterment of a dinosaur of the genus Diclonius from beds overlying those in which the leaves occur. These facts furnish another instance of that modern aspect of the upper cretaceous flora on which I have elsewhere insisted, and which has been a fertile source of error with reference to the age of beds of this formation in the west. It is interesting to note that beds of this age in western Canada contain the modern Onoclea sensibilis of America, along with Davallia tenuifolia, also modern, but now Asiatic.

J. Wm. Dawson.

Lateral movements of the earth's crust.

While observations are being made for the purpose of investigating 'variations of latitude,' is it not desirable that the U. S. coast and geodetic survey should make simultaneous observations with a view to discover, if possible, whether or not places along our coasts are suffering changes of latitude or longitude, or both, due to lateral movements of the earth's crust?

If it is true that during geological history large lateral movements of the earth's crust have taken place, and if such changes are still going on, it would seem inevitable, that, in regions where lateral displacements are taking place, landmarks should suffer a change of latitude or longitude, or of both, according to the direction of yielding to lateral pressure, and that places located upon regions suffering compression or folding should be moved, to some extent, bodily toward places in adjoining regions, toward which the movements take place, but which are not themselves undergoing displacements.

Since vertical movements of the earth's crust are taking place at measurable rates, and since, in the past, lateral movements appear to have exceeded the vertical, it might be expected that lateral movements are now taking place at measurable rates. Of course, if the superficial strata are not involved in these movements, the deeper strata only yielding, surface landmarks could not reveal the movement; but in this case, and in case folds of the superficial strata along our coasts are in process of evolution, it would seem that such changes might be discovered by sinking deep vertical shafts at intervals along lines normal to the coast. These carefully surveyed at intervals during one or two centuries, it would seem, should show a measurable warping or tilting if such movements are going on.

F. H. King.

River Falls, Wis.

Silver in mounds.

In the number of *Science* for May 22 you have an article on 'Silver from a Pennsylvania mound,' which leads me to speak of a recent find here. Within the city limits, on the west side of the river, and in the region of a group of mounds now mainly removed, there were recently found two nodules of nearly pure silver, weighing together upward of twelve pounds, together with a small piece of silver-foil. The nodules were irregular in shape, with some admixture of earthy material; but a competent chemist pronounces them essentially pure silver. With them was found a large copper axe, a large sea-shell (Pyrula?), bone spears, human bones, etc., — the usual contents of the mounds (in this region) of the so-called mound-builders. A more complete examination of these articles will be made. E. A. STRONG.

Grand Rapids, Mich., June 11.

Mound-building tribes.

'Name the mound-building tribes,' is the demand now made of those holding the Indian theory. The mound testimony so far obtained (much of it by the bureau of ethnology, and yet unpublished), taken in connection with the historical, traditional, and linguistic evidence, leads to the following conclusions: —

1. That the ancient works in eastern Arkansas, north of the Arkansas River, were chiefly built by the 'Akansea' (Quapaws or Kappas), and other allied tribes of the Dakotan stock encountered by DeSoto, and found still occupying this region when first visited by the French explorers. The evidence in support of this opinion seems to be well-nigh conclusive.

2. That some ancient works recently discovered in Pontotoc and Union counties, Miss., are probably due to the Chickasaws, who are known to have inhabited this region from the time of DeSoto's expedition until a recent date. These works have been visited and carefully explored by a bureau assistant, who discovered in one of the mounds, in addition to a number of the usual mound-builder's relics found in such works, one blade of a pair of scissors, the blade of an iron 'case-knife,' and a small silver plate stamped with the Spanish coat-of-arms. The vestiges of aboriginal art present marked differences from those found in Arkansas, western Tennessee, and the more southern portions of Mississippi. Of course the data so far obtained, relating to this locality, are too meagre to justify a decided conclusion.

3. That most of the antiquities of Alabama and Georgia are attributable to the Muskoki tribes. But the mound explorations indicate that the south-west corner of Georgia, and immediately adjoining portions of Florida, were occupied in mound-building times by a different people. It is somewhat significant that Mr. Gatschet ('Migration legend of the Creeks') locates the Uchees in precisely this area. Some specimens of pottery indicate contact with the whites, but others are more ancient. The indications are that the same people occupied this region at two different periods.

4. That the Cherokees were mound-builders, and that they were the authors of most of the works of western North Carolina and eastern Tennessee. I have given elsewhere (*Magazine of American history*, May, 1884) some reasons for this belief. Subsequent explorations have served to strengthen this opinion. A number of mounds around the site of old Fort Loudon, Monroe county, Tenn. (one of them of large size), recently opened, furnish what seem to be absolutely connecting-links between the mound-builders and Indians. From the large one, containing ninety-one skeletons, were taken dozens of polished celts; several shell masks; some engraved shells; a gallon or more of shell beads, some of them pearls; vessels of clay of ancient type; bone implements; hundreds of perforated shells; *a few pipes of a comparatively modern Cherokee type; four copper hawk-bells with shell-bead and pebble rattles;* discoidal stones, etc. No indication of intrusive burials.

But the mound testimony in regard to this tribe does not stop here. It indicates that to them we must attribute the works of Kanawha valley, near Charleston, those at Grave Creek, and the typical works of southern Ohio: in other words, it is in accord with the tradition mentioned by Haywood, and the theory which identifies them with the Talegwi. The proof is circumstantial, but the chain is unbroken: the pipes alone are sufficient to show this. We can trace them back along their line of migration to Iowa. The works of Ohio indicate several different waves of population, and occupancy for a greater or less length of time by different tribes; but the works of the Talegwi (Cherokees) are generally easily distinguished. The mound testimony absolutely forbids the idea that the Ohio mound-builders went south to the Gulf states, and merged into the Muskoki family, or were represented by the Natches.

5. That the track of the Shawnees can be traced by their works from southern Illinois to north-eastern Georgia. They were undoubtedly the authors of the box-shaped 'stone graves,' or cysts, found south of the Ohio River, and the other works of that region directly connected with these graves. While it is probable they entered it from the west, possibly along the line of the lower Missouri River, the works at the eastern end of the elongate area bear the marks of greatest age, unless we attribute to them the Cahokia pyramid and its companions. The region of the Cumberland valley and middle Tennessee was evidently their chief and most permanent seat of power. The later occupancy by them and by the Delawares, of various points in Ohio, is generally indicated by their stone coffins and mode of burial.

6. That a large portion of the works of Kentucky differ from all others east of the Mississippi, north-eastern Missouri alone presenting any thing similar. The only probable solution of the puzzle is, that a tribe which once inhabited this section has become extinct, or fled west, and was absorbed in some other tribe, or became nomadic. And, last, that Morgan's theory that the mound-builders were from the pueblo Indians is without foundation.

The evidence on which these conclusions are based cannot be presented here, but will be given in the report on the mound explorations of the bureau of ethnology for the years 1882–85, now being prepared for publication. CYRUS THOMAS.

Abert's squirrel.

That the credit of first publishing a drawing of Abert's squirrel may be given to the proper person, I beg, through you, to call Dr. Shufeldt's attention to the illustration of it that is contained in Senate ex-doc. No. 59, 32d congress, 2d session, 1853: "Report on the natural history of the country passed over by the exploring expedition under the command of Brevet Capt. L. Sitgreaves, U. S. topographical engineers, during the year 1851, by S. W. Woodhouse, M.D., surgeon and naturalist to the expedition."

Plate 6 is a full-length view of the animal, and on pp. 53, 54, is a description in detail of this Sciurus.

New York, June 15. L. S. FOSTER.

A complete fibula in an adult living carinate-bird.

In reference to the important anatomical point contained in the letter of Dr. G. Baur to *Science* (No. 118) in regard to the fibula of Pandion, I would like to invite your correspondent's attention to the condition of the fibula in the adult Colymbus septentrionalis. I have in my temporary possession a complete skeleton of an adult individual of this diver, kindly lent me by the Smithsonian institution (spec. 13,646) for another purpose. In it the fibula is found, as I have drawn the specimen in the accompanying cut, for the right limb, though it is seen equally well in both. The fibula has been drawn in black for its entire length, so that its exact form and relation to the tibio-tarsus may be properly appreciated. From the point *a* to *b* it anchyloses with the shaft of the other leg-bone, though it stands out quite prominently from it, leaving no doubt as to its identity. Knowing as we do that the part indicated in the cut by *c* represents one of the tarsal elements, it is no more than we should expect to have a complete fibula terminate, as it does in this bird, at *b*; and this part, in common with Pandion, is found upon the antero-lateral aspect rather than in front of the tibio-tarsus, as in the Jurassic Archaeopteryx.

BONES OF RIGHT THIGH AND LEG OF ADULT COLYMBUS SEPTENTRIONALIS. REDUCED ONE-HALF.

F, femur; *P*, patella; *Fb*, fibula (in black); *T*, tibio-tarsus; *a*, point where anchylosis commences; *b*, distal extremity of fibula; *c*, the united tarsal element; *d*, a fibrous loop for tendon; *e*, the large oblique fibrous loop for extensor tendons; *f* indicates the position of the bony bridge that confines the deep extensors.

Dr. R. W. Shufeldt.

Fort Wingate, N. Mex., June 8.

The classification and paleontology of the U.S. tertiary deposits.

Under this head a note was published in the number of June 12 of this journal, on the first part of my article, 'The genealogy and the age of the species in the southern old tertiary,' in the *American journal of science* for June. I refer those readers of *Science* who are interested in this matter to the second part of this article, which will appear in the July number of the same journal. Dr. Otto Meyer.

New Haven, Conn., June 15.

HOW TO REACH THE GRAND CAÑON.

Although the Grand Cañon of the Colorado was a good while ago made famous as to its lower part by Ives and Newberry, and the upper by Powell, and although most interesting parts of it are nearly approached by one of the great transcontinental railways, yet very few people seem to know how easy it is to visit it, — easy, that is, to one who is crossing the continent by the Atlantic and Pacific railroad. It was almost by accident that we came to know of this accessibility, and to take advantage of it.

We know not what facilities there may be for reaching the lower end of the cañon from 'The Needles,' where the road crosses the Rio Colorado; but the Peach-Spring station, where this road approaches within twenty-three miles of the river, at its strong southern bend, is about six hours east of 'The Needles,' and on the plateau about five thousand feet higher. From this point a rapid and easily traversed descent leads down to the river, and into as majestic and peculiar cañon scenery as is anywhere to be seen. Unfortunately the trains, both from the east and the west, at present arrive at this little watering-station between two and three o'clock in the morning; and intending visitors will find it well, if not exactly necessary, to notify the station-master or the 'stage proprietor' in advance, so as to secure lodgings for the remainder of the night. Mr. Farlee, the stage proprietor, into whose hands they will fall, provides three or four comfortable beds; the restaurant of the station, which supplies the employees of the railroad, will furnish a tolerable breakfast; and a three-seated wagon, upon the buckboard principle, drawn by four experienced horses, makes a really comfortable conveyance. All that the traveller needs to provide is a sun-umbrella, — an article which will probably be needed at any season. A quick descent of four thousand feet into a narrow ravine is sure to be attended by a corresponding rise in temperature; and shade during the journey is not abundant.

Dr. Newberry and his exploring party were the first white people to make this trip, in April, 1858; and his account of it in Ives's report upon the Colorado River of the west, along with the woodcut on p. 99 and the annexed plate vi., and plate i. of the geological part, opposite p. 54, will give a fair idea of what is to be seen. Nothing is changed, except that the Indian trail, over which his pack-mules made their way with much difficulty, is now replaced with a passable wagon-road of Mr. Farlee's making. Very enterprising and hurried people make the trip in a single day, especially in the long days of spring, and so resume the railroad by the next (daily) train, the journey back and forth being made in the early morning and in the evening hours. But, indeed, two days should be given to it, even by the transient sight-seer, lodging in the

'hotel' in the bottom of the cañon. This is a board shanty of a single room below, with a kitchen attached, and two bedrooms under the roof above. Primitive as the accommodations are, and although, when there is no press of company expected, the functions of stage proprietor, road-owner, driver, guide, landlord, and cook are all merged in one person, we found that person adequate to all those duties; and even the lady of our party was comfortably cared for, both as to bed and board. When this extraordinary place comes to be better known and more largely visited, ampler accommodations will doubtless be provided, both in the cañon and at the railway-station. The 'hotel' stands at the junction of the Peach-Spring Cañon and that of the Diamond River, close to the refreshing stream of pure water. The Diamond-River Cañon, of which Dr. Newberry gives two good illustrations, was explored upward for two or three miles on the afternoon of the first day. The following morning suffices for the junction of this cañon with the Colorado, which is near by, and for the views up and down the river, which are to be had for less than an hour of climbing. Altogether, there is nothing like this cañon. The far-famed Yosemite is more beautiful and more varied, but not more magnificent, nor half so strange and weird.

I may be allowed to add the remark that the botany of these lateral cañons is very interesting, and inviting to a longer stay. It had been so well explored by Mr. and Mrs. Lemmon a year before, that we could not expect our hurried visit to be rewarded with any thing absolutely new. But here we saw an abundance of the singular and striking Fouquieria in flower, and that alone well repaid the toils of the excursion.

This is the only accessible point at which a descent can be made into the bed of the Grand Cañon. But from Flagstaff — a station about nine hours farther east, and at considerably greater elevation, in a district of pine-forests, and close to the beautiful and snow-clad San Francisco mountains — a wagon-journey of two days over the mesa will take a party to the Marble Cañon, described and illustrated by Powell, where the Colorado flows twenty-five hundred feet below, between unbroken vertical walls of many-colored marbles. Moreover, the neighborhood of Flagstaff abounds in cliff-dwellings and cave-dwellings, the latter comparatively little known; and altogether this seems to us a most inviting place of summer resort.

Journeying eastward, the traveller passes one of the most interesting of the Indian pueblos, that of Laguna; and that of Zuñi is well within reach from Fort Wingate.

A. G.

THE WASHINGTON MONUMENT, AND THE LIGHTNING STROKE OF JUNE 5.

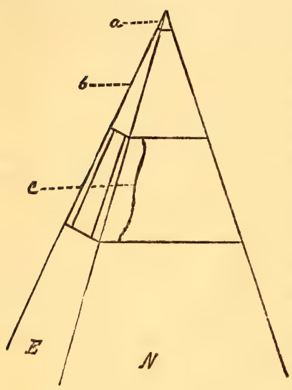
The recent injury to the Washington monument by lightning has attracted attention throughout the country to such a degree that a short statement of the facts in the case will doubtless be of interest to the readers of *Science.* On the afternoon of June 5 a thunderstorm of no unusual character passed over Washington. At about fifteen minutes past three there was a single burst of thunder of some violence, which was about the only notable electrical disturbance of the afternoon. Although it had successfully passed through disturbances apparently much more violent on one or two previous occasions, this time the monument was 'struck,' and some damage done to one of the stones near the apex. Two men who were inside of the structure, at the base, describe the sound produced as resembling the simultaneous discharge of a great number of cannon, and declare that the 'whole monument trembled.' Two others were in a small wooden building, used as an office, near by. One of them was looking out of the window, away from the monument, toward the north. He affirms, in the most positive manner, that he saw a ball of fire, which he says was as large as his fist, coming directly towards the window out of which he was looking. Both he and his companion (who was not looking out of the window, and who did not see the ball of fire) seem to have felt something of the usual effect of a shock. Those who were within the monument say they felt no unusual sensations except those produced by the noise.

When the monument was examined from the ground with the unaided eye, no injury could be detected. On applying a good telescope, however, it was seen that one of the stones just below the capstone was split from top to bottom, the crack produced being about four feet long, and it was open to the extent of about two inches. A small corner of the lower corresponding angle of the capstone had also been carried away, this doubtless resulting from the opening of the crack in the stone upon which it rested.

The appearance of the apex is fairly represented in the sketch, in which (*a*) represents the aluminum tip, (*b*) the capstone, and (*c*)

shows the crack in the stone in the next lower course.

Col. T. L. Casey, U.S.A., the engineer in charge of the construction of the monument, requested Professors Rowland of Baltimore, Newcomb of the U. S. navy, and Mendenhall of the signal-service, to examine the monument, and recommend such additions to the present arrangements for protection from lightning as would seem to them necessary and sufficient. It was ascertained on examination, that, with the exception of that shown in the sketch, the monument showed no evidence whatever of having received the stroke. A careful examination of the tip of the aluminum apex has not yet been made; but it seems likely that it will be found to be somewhat blunted by fusion, as is so often the case even where no other effect of the stroke is to be seen.



This aluminum pyramid is secured to the capstone by a heavy copper bolt one and a half inches in diameter. From the end of this, four copper rods, each three-quarters of an inch in diameter, are carried to the extremities of four heavy iron columns extending to the base of the monument, inside of which the elevator runs. As originally put in, these rods are bent out towards the four corners of the pyramid near which they run on their way to these iron columns. Just where one of these is nearest to the angle of the pyramid, and hence nearest to the outside of the structure, the rupture occurred; and to this must doubtless be attributed the localization of the stroke.

The damage done to the monument is in reality very small, and can easily be repaired; but the accident is exceedingly instructive to those interested in lightning protection. The conducting power of the interior seems to be ample for any discharge which could possibly occur, and no evidence appears of any weakness in this respect; but it is evident that the aluminum apex alone does not possess sufficient collective or distributing power, and the improvements suggested by the committee will doubtless be in the direction of increasing that power by the addition of more metal.

M.

Washington, D.C., June 15.

THE PERIODICAL CICADA.[1]

JUST at this time considerable interest is manifested in this curious insect, because of the concurrence of two extensive broods, the one belonging to the typical septendecim form, the other to the tredecim race. These two broods appeared simultaneously in 1664, and will not concur again till the year 2106. The following are the localities in which these two broods will respectively occur: —

TREDECIM (1872, 1885).

Illinois. — Jackson, Union, Macoupin counties.

Missouri. — St. Louis, Boone counties.

Georgia. — DeKalb, Gwinnett, Newton counties.

Tennessee. — Madison county, and northern portion of the state.

Mississippi. — Copiah county, Oxford, and eastern portion of the state.

Louisiana. — Carroll Parish.

Kansas. — Phillips county.

Arkansas. — Flat Bayou.

The existence of this brood has been verified in past years in the parts of Illinois, Missouri, Tennessee, Mississippi, and Arkansas, indicated; but the localities in Kansas, Georgia, and perhaps Louisiana, require further confirmation this year.

SEPTENDECIM (1868, 1885).

New York. — Kings, Monroe counties.

Massachusetts. — Fall River, south-east portion of the state.

Vermont. — Rutland.

Pennsylvania. — Lancaster.

Ohio. — Green, Franklin, Columbiana, Pike, Miami counties, and vicinity of Toledo.

Indiana. — Tippecanoe, Delaware, Vigo, Switzerland, Hendrick, Marion, Dearborn, Wayne, Floyd, Jefferson counties.

Michigan. — South-eastern portion.

Delaware. — Very generally.

Maryland. — Very generally.

District of Columbia. — Very generally.

Virginia. — Very generally.

Kentucky. — Around Louisville.

Georgia. — Habersham county.

From chronological data, the fact that seventeen years or thirteen years are respectively required for the underground development of this insect, according to the race, is fully established, one of the first recorded septendecim broods having been observed every seventeen years since 1715. Such anomalous and excep-

[1] Extracts from a paper read to the Biological society of Washington, May 30.

tional facts in natural history always provoke scepticism, and the facts recorded regarding our cicada's hypogean life have shared in this tendency. Hence a few facts, especially such as bear on the development of the larva, will not prove uninteresting.

Of the tredecim brood which appeared in 1868, I have taken pains to follow the larval development as far as possible from year to year, my observations having been made in St. Louis county, Mo. Repeated efforts to rear the young larvae in confinement proved unsuccessful; and it was necessary to resort to careful and repeated digging out-doors in order to watch the growth from year to year. One of my employees at Cadet, Mo., has also been instructed to carefully pursue the same subject, and I have repeated the digging since residing in Washington. These observations have in all cases been made in special localities where the date of entering the ground was well known and observed. I have thus been able to follow the larvae for the first six years with great care, and for subsequent years with less care and continuity. As we might expect from the chronological history of the species, the development of the larva is extremely slow; and at six years old it has hardly attained one-fourth of its full size. Notwithstanding this slow development, moulting takes place frequently; i.e., the number of larval stages is more than one per annum, and probably twenty-five or thirty in all, whereas in the Homoptera generally — the suborder to which Cicada belongs — it ranges from two to four. In any hypogean insect which continually uses its claws in burrowing, the need of shedding and renewal of those organs is apparent, and may afford the chief explanation of this repeated exuviation, though the slow development is a factor; since my own experience has shown, in the larvae of other orders, that, in proportion as development is slow, exuviation is frequent. As the claws of the front tibiae are the chief instruments used in burrowing, the tarsi become useless or obstructive, and are gradually reduced, and finally lost. They are then regained suddenly during one of the later moults, but so articulated that they are thrown back on the inside of the tibiae, and form a good brace for strengthening these. They are thus out of the way for underground work, and come into use, with their well-preserved claws, only when the pupa issues from the ground, and ascends for the final change.

Much difference of opinion has been expressed by different writers as to the food of the larva; and this is not to be wondered at, from the fact that there is great difficulty in observing it feed. Dr. G. B. Smith insisted that it obtained its nourishment from the moisture of the earth, through capillary hairs at the tip of the proboscis; while many others have seen it with its beak inserted in the roots of trees, and pumping the sap therefrom. The former method is insisted on by Dr. Smith from his own observations; but while I think it not improbable, especially during its earlier larval life, that the cicada may feed on earth-exudation, — a belief which receives support from the well-known fact that this cicada will issue from ground that has been cleared of timber and cultivated for nearly seventeen years, and that other species are known to issue from the prairies, — the liquid is evidently pumped up in the ordinary way. The truth of the matter seems to be that the cicada larva can and does go for long periods without nourishment, where such fasting is necessitated; and that in the earlier years of its development, more particularly, it feeds on the rootlets or radicles, not only of trees, but of herbaceous plants. In my own observations I have rarely found it more than two feet below the surface during the first six or seven years of its life, and almost invariably in an oval cell, and more often away from roots than near them; yet I have also found it with beak inserted, and it will often hang fast by the beak after being unearthed. That the larva is capable of going to great depths is well attested by observers. Many of such reports may be based on the unobserved tumbling of the larva from higher levels; but, where the insect has been observed to issue from the bottoms of cellars ten feet deep, the information would certainly seem to be reliable.

The method of burrowing and making its cells is quite interesting. With the strong front tibial claws it scratches away the walls of its cell just as one would do with a pick; and if it is rising, so that the earth removed naturally falls to the posterior end of the burrow, it simply presses the detached portions on all sides, and especially on the end of the cavity, by means of its abdomen and middle and hind legs. If, however, it is burrowing downward, and the loose soil has to be pressed against the top of the cavity, it uses its broad front femora very dexterously in making a little pellet of the soil, and in placing it on the clypeal or front part of the head, when the load is carried up, and pressed against the top of the cavity. The motions made in cleaning its fore-arms remind one very forcibly of those made by a cat in cleaning its face. The femora

and bent tibiae are rubbed over the clypeus, the numerous stiff hairs on which act like a comb or a brush in freeing the spine of dirt.

As the time approaches for the issuing of the pupa, it gradually rises nearer and nearer to the surface; and, for a year or two before the appearance of any given brood, the pupa may be dug up within one or two feet of the surface.

In the year of their ascent, from the time the frost leaves the ground, they are found close to the surface, and also under logs and stones, seeming to await the opportune moment, and apparently without feeding. They begin to rise from about the 20th of May in more southern localities, and but little later farther north. In Washington, the present year, they began to rise in scanty numbers about the 23d, and were perhaps most numerously rising on the night of the 27th. Those in the city were somewhat earlier than those in the woods just over on the Virginia side. The unanimity with which all those which rise within a certain radius of a given tree crawl in a bee-line to the trunk of that tree, is most interesting. To witness these pupae in such vast numbers that one cannot step on the ground without crushing several, swarming out of their subterranean holes and scrambling over the ground, all converging to the one central point, and then in a steady stream clambering up the trunk, and diverging again on the branches, is an experience not readily forgotten, and affording good food for speculation on the nature of instinct. The phenomenon is most satisfactorily witnessed where there is a solitary or isolated tree.

The pupae begin to rise as soon as the sun is hidden behind the horizon, and they continue, until, by nine o'clock, the bulk of them have risen. A few stragglers continue until midnight. They instinctively crawl along the horizontal branches after they have ascended the trunk, and fasten themselves in any position, but preferably in a horizontal position on the leaves and twigs. In about an hour after rising and settling, the skin splits down the middle of the thorax from the base of the clypeus to the base of the metanotum, and the forming cicada issues. Ecdysis is always an interesting phenomenon, and, when closely watched in our cicada, cannot fail to entertain.

There are five marked positions or phases in this act of evolving from the pupa-shell; viz., the straight or extended, the hanging head downward, the clinging head upward, the flat-winged, and, finally, the roof-winged. In about three minutes after the shell splits, the forming imago extends from the rent, almost on the same plane with the pupa, with all its members straight, and still held by their tips within the exuvium. The imago then gradually bends backwards, and the members are all loosened and separated. With the tip of the abdomen held within the exuvium, the rest of the body hangs extended at right angles from it, and remains in this position from ten to thirty minutes or more, the wing-pads separating, and the front pair stretching at right angles from the body, and obliquely crossing the hind pair. They then gradually swell, crimp, and curl, until they form a more or less perfect loop; and during all this time the legs are becoming firmer, and assuming the natural positions. Suddenly the imago bends upward with a great deal of effort, and, clinging with its legs to the first object reached, — whether leaf, twig, or its own shell, — withdraws entirely from the exuvium, and hangs for the first time with its head up. Now the wings perceptibly swell and expand, until they are fully stretched, and hang flatly over the back, perfectly transparent with beautiful white veining. As they dry, they assume the roofed position, and during the night the natural colors of the species are gradually assumed.

The time required in the transformation varies; and though from the splitting of the skin, and the full stretching of the wings in the flat position, the time is usually about twenty minutes, it may be, under precisely similar conditions, five or six times as long. But there are few more beautiful sights than to see this fresh-forming cicada in all the different positions, clinging and clustering in great numbers to the outside lower leaves and branches of a large tree. In the moonlight, such a tree looks for all the world as though it were full of beautiful white blossoms in various stages of expansion.

That this insect, in its distribution and in its numbers, has been and is being seriously affected by our civilization, must be apparent to every observer. The records show that the numbers have decreased in the successive appearances of certain broods, owing largely to the presence of our domestic animals in the woods. Then, again, the clearing of land and the building of towns and cities have all had their effect upon the decrease of this cicada. There are doubtless many places in Brooklyn, N.Y., where the insect appeared seventeen years ago, in which there will be none the present year. And similarly, I believe that whereas around every tree that has been planted more than seventeen years, or upon land that grew trees seventeen years ago, the

insect is now abundant in Washington, it will scarcely be noticed in any part of the District seventeen years hence. I base this opinion upon a new phase in the cicada history; viz., the presence of the English sparrow. It is the first time, perhaps, in the history of the world, that Passer domesticus has had an opportunity of feeding upon this particular brood of Cicada septendecim: and so ravenously and persistently does this bird pursue its food, that the ground is strewn with the wings of the unfortunate cicada wherever these have been at all numerous; so that, considering the numbers of the sparrow and their voracity, very few of the cicada will be left long enough to procreate and perpetuate the species in this District.

* * * * *

THE GEOLOGY OF NATURAL GAS.

The recent introduction of natural gas into general use as a source of heat for industrial and domestic purposes has raised it from the rank of a mere curiosity to one of the earth's most valuable treasures.

To the reader unacquainted with the great change natural gas has effected in all industries where it can be obtained, the following quotation from an article in *Macmillan's magazine* for January, written by Mr. Andrew Carnegie, the chief iron master of Pittsburgh, will be a revelation: "In the manufacture of glass, of which there is an immense quantity made in Pittsburgh, I am informed that gas is worth much more than the cost of coal and its handling, because it improves the quality of the product. One firm in Pittsburgh is already making plate glass of the largest sizes, equal to the best imported French glass, and is enabled to do so by this fuel. In the manufacture of iron, and especially in that of steel, the quality is also improved by the pure new fuel. In our steel-rail mills we have not used a pound of coal for more than a year, nor in our iron mills for nearly the same period. The change is a startling one. Where we formerly had ninety firemen at work in one boiler-house, and were using four hundred tons of coal per day, a visitor now walks along the long row of boilers, and sees but one man in attendance. The house being whitewashed, not a sign of the dirty fuel of former days is to be seen; nor do the stacks emit smoke. In the Union iron-mills our puddlers have whitewashed the coal-bunkers belonging to their furnaces. Most of the principal iron and glass establishments in the city are to-day either using this gas as fuel, or making preparations to do so. The cost of coal is not only saved, but the great cost of firing and handling it; while the repairs to boilers and grate-bars are much less."

This new fuel, which bids fair to replace coal almost entirely in many of our chief industrial centres, has not received that attention from the geologist which its importance demands. So far as the writer is aware, nothing has been published on the subject which would prove of any value to those engaged in prospecting for natural gas, and it is the existence of this blank in geological literature that has suggested the present article.

Practically all the large gas-wells struck before 1882 were accidentally discovered in boring for oil; but, when the great value of natural gas as fuel became generally recognized, an eager search began for it at Pittsburgh, Wheeling, and many other manufacturing centres.

The first explorers assumed that gas could be obtained at one point as well as another, provided the earth be penetrated to a depth sufficiently great; and it has required the expenditure of several hundred thousand dollars in useless drilling to convince capitalists of this fallacy which even yet obtains general credence among those not interested in successful gas companies.

The writer's study of this subject began in June, 1883, when he was employed by Pittsburgh parties to make a general investigation of the natural-gas question, with the special object of determining whether or not it was possible to predict the presence or absence of gas from geological structure. In the prosecution of this work, I was aided by a suggestion from Mr. William A. Earsenian of Allegheny, Penn., an oil-operator of many years' experience, who had noticed that the principal gas-wells then known in western Pennsylvania were situated close to where anticlinal axes were drawn on the geological maps. From this he inferred there must be some connection between the gas-wells and the anticlines. After visiting all the great gas-wells that had been struck in western Pennsylvania and West Virginia, and carefully examining the geological surroundings of each, I found that every one of them was situated either directly on, or near, the crown of an anticlinal axis, while wells that had been bored in the synclines on either side furnished little or no gas, but in many cases large quantities of salt water. Further observation showed that the gas-wells were confined to a narrow belt, only one-fourth to one mile wide, along the crests of the anticlinal folds. These facts seemed to connect gas territory

unmistakably with the disturbance in the rocks caused by their upheaval into arches, but the crucial test was yet to be made in the actual location of good gas territory on this theory. During the last two years, I have submitted it to all manner of tests, both in locating and condemning gas territory, and the general result has been to confirm the anticlinal theory beyond a reasonable doubt.

But while we can state with confidence that all great gas-wells are found on the anticlinal axes, the converse of this is not true; viz., that great gas-wells may be found on all anticlinals. In a theory of this kind the limitations become quite as important as, or even more so than, the theory itself; and hence I have given considerable thought to this side of the question, having formulated them into three or four general rules (which include practically all the limitations known to me, up to the present time, that should be placed on the statement that large gas-wells may be obtained on anticlinal folds), as follows: —

(*a*) The arch in the rocks must be one of considerable magnitude; (*b*) A coarse or porous sandstone of considerable thickness, or, if a fine-grained rock, one that would have extensive fissures, and thus in either case rendered capable of acting as a reservoir for the gas, must underlie the surface at a depth of several hundred feet (five hundred to twenty-five hundred feet); (*c*) Probably very few or none of the grand arches along mountain ranges will be found holding gas in large quantity, since in such cases the disturbance of the stratification has been so profound that all the natural gas generated in the past would long ago have escaped into the air through fissures that traverse all the beds. Another limitation might possibly be added, which would confine the area where great gas-flows may be obtained to those underlaid by a considerable thickness of bituminous shale.

Very fair gas-wells may also be obtained for a considerable distance down the slope from the crest of the anticlinals, provided the dip be sufficiently rapid, and especially if it be irregular, or interrupted with slight crumples. And even in regions where there are no well-marked anticlinals, if the dip be somewhat rapid and irregular, rather large gas-wells may occasionally be found, if all other conditions are favorable.

The reason why natural gas should collect under the arches of the rocks is sufficiently plain, from a consideration of its volatile nature. Then, too, the extensive fissuring of the rock, which appears necessary to form a capacious reservoir for a large gas-well, would take place most readily along the anticlinals where the tension in bending would be greatest.

The geological horizon that furnishes the best gas-reservoir in western Pennsylvania seems to be identical with the first Venango oil-sand, and hence is one of the Catskill conglomerates. This is the gas-rock at Murraysville, Tarentum, Washington, Wellsburg, and many other points. Some large gas-wells have been obtained in the subcarboniferous sandstone (Pocono), however, and others down in the third Venango oil-sand (Chemung).

In Ohio, gas-flows of considerable size have been obtained deep down in the Cincinnati limestone, while in West Virginia they have been found in the Pottsville conglomerate: hence natural gas, like oil, has a wide range through the geological column, though it is a significant fact that it is most abundant above the black slates of the Devonian.

Of the composition, probable origin, extent of gas territory in the country, and many other interesting points connected with natural gas, the necessary brevity of this article forbids any mention; but the writer has in preparation a more general paper on the subject, in which these and kindred questions will be discussed with more detail. I. C. White.

THE EFFECTS OF COLD ON LIVING ORGANISMS.

Mr. Coleman and Professor McKendrick have made some remarkable experiments [1] on the effect of low temperatures on living organisms, particularly microbes, using for this purpose the cold-air machinery invented by Mr. Coleman, which, in its ordinary working, delivers streams of air cooled to about 80° below zero (— 63° C.), but by certain modifications as low temperatures can be secured as have yet been produced in physical researches. The actual temperatures in these experiments were taken by an absolute alcohol thermometer, made by Negretti and Zambra, and checked by a special air thermometer devised by Mr. Coleman.

The experiments consisted in exposing for hours to low temperatures putrescible substances in hermetically sealed tins or bottles, or in flasks plugged with cotton wool. The tins or flasks were then allowed to thaw, and were kept in a warm room, the mean temperature of which was about 80° F. They were then opened, and the contents submitted to microscopical examination. The general result may be stated thus: The vitality of micro-organisms cannot be destroyed by prolonged exposure to extreme cold. It is clear, therefore, that any hope of preserving meat by permanently sterilizing it by cold must be

[1] Proc. Philos. soc. Glasgow, March 4, 1885.

abandoned; for the microbes, which are the agents of putrefaction, survive the exposure.

Some of the experiments on which this conclusion rests are briefly described. Meat in tins, exposed to — 63° C. for six hours, underwent (after thawing) putrefaction with generation of gases. Trials with fresh urine showed that freezing at very low temperatures delayed the appearance of the alkaline fermentation, but a temperature of — 63° C. for eight hours did not sterilize the urine. Samples of fresh milk exposed to temperatures of from zero to — 80° F. for eight hours, curdled, and showed the well-known Bacterium lactis; and, so far as could be observed, freezing did not delay the process after the flasks were kept at a temperature of about 50° F. Similar results were obtained with ale, meat-juice, vegetable infusions, etc.

It is probable that the micro-organisms were frozen solid. One cannot suppose that in these circumstances any of the phenomena of life take place: the mechanism is simply arrested, and vital changes resume their course, when the condition of a suitable temperature is restored. These considerations led the authors to examine whether any of the vital phenomena of higher animals might be retained at such low temperatures. They ascertained that a live frog may be frozen through quite solid in about half an hour at a temperature of — 20° F. to — 30°. On thawing slowly, in two instances the animal completely recovered. After longer exposure the animals did not recover. In two cases frogs were kept in an atmosphere of — 100° F. for twenty minutes, and although they did not revive, yet, after thawing out, their muscles still responded feebly to electrical stimulation. One experiment was performed on a warm-blooded animal, — a rabbit. The cold-blooded frog became as hard as a stone in from ten to twenty minutes, but the rabbit produced in itself so much heat as enabled it to remain soft and comparatively warm during an hour's exposure to — 100° F. Still its production of heat was unequal to make good the loss; and every instant it was losing ground, until, at the end of the hour, its bodily temperature had fallen about 56° F. below the normal, but was still 143° F. above the surrounding temperature. When taken out, the animal was comatose, and reflex action was abolished. Placed in a warm room, its temperature rose rapidly, and the rabbit completely recovered.

The observations are of great value, and highly suggestive. Those upon the rabbit indicate that death from cold is preceded by loss of consciousness, owing to the early suppression of the activity of the gray matter of the encephalon. This confirms the belief that death by freezing is comparatively painless. The viability of microbes at low temperatures has also been demonstrated by Pictet and Yung,[1] who found that various bacilli can survive — 70° C. for a hundred and nine hours. After such exposure, Bacillus anthracis retained its virulence when injected into a living animal.

We cannot refrain from asking, Are not frozen micro-organisms the means of disseminating life through the universe? An affirmative answer is at least a better hypothesis than the assumption of spontaneous generation to account for the origin of life on the earth. May not life be coeval with energy? May it not have always existed?

CHARLES S. MINOT.

[1] *Comptes rendus*, Paris, xcviii. 747.

PREHISTORIC AMERICAN SCULPTURES.

AMONG the many interesting sculptures in stone of the prehistoric Americans are those found in Guatemala, which were first described by Dr. Habel in No. 269 of Smithsonian contributions to knowledge, 1879. These were principally fallen monoliths which were discovered in 1862, near the village of Santa Lucia Cosumalhupa, near the base of the Volcano del Fuego. Several of these carvings were afterwards secured by Dr. Bastian for the Berlin museum. The majority of those figured by Dr. Ha-

HUMAN SACRIFICE. BAS-RELIEF AT SANTA LUCIA COSUMALHUPA. (*La Nature.*)

bel are in cavo-relievo, similar to many of the Assyrian sculptures. Most of these carvings represent sacrifice and adoration. Dr. Habel considers that they represent a period of culture when the people were passing from the worship of the sun and other heavenly bodies to that of man, or the beginning of anthropomorphism. One of these monoliths, which is a stone twelve feet high, three feet wide, and two feet thick, is reproduced in the accompanying figure. It is supposed to represent a priest offering the sacrifice of a human being. He holds the head in his left hand, and in his right is the knife with which he has severed the head from the body upon which he stands. At the lower part of the stone two attendant figures are represented, each carrying a human head. One of these smaller figures has a skull for a head, and is supposed to symbolize death. This figure also occurs on other of these carved stones. The elaborate ornamentation of the naked body of the priest is characteristic of all the figures given by Habel. In this instance the head-dress is in the form of a crab, and the hair is arranged in a sort of queue, with many decorations appended. The ear has a small ring in the lobe, from which hangs a larger ring. Around the neck is a cord and tassel, and about the waist is an elaborate girdle having at the back the head of an animal. Just below the right knee there is a garter. This occurs on all similar figures. The left foot is protected by a sandal. In some of the other figures both feet have sandals, and in one both are naked. The curved figures above the right hand of the priest, and below the body of the victim, are supposed to represent speech, as they occur with various modifications in several other carvings. In connection with these singular Central-American works of art, it is of interest to recall the carved shells found in mounds in the United States, and recently figured by Mr. Holmes in the report of the Bureau of ethnology, as the expression of ideas in a similar manner suggests a common origin.

THE PROPOSED CHANGE IN THE ASTRONOMICAL DAY.

Two eminent astronomers have recently given their views on the proposed change of the astronomical day, and both are inclined to favor the change. This discussion, which is of particular interest to astronomers, is on the sixth resolution of the Prime-meridian conference of Washington, — "that the conference expresses the hope, that, as soon as may be practicable, the astronomical and nautical days will be arranged everywhere to begin at mean midnight." The present custom, as we know, is for the astronomer to begin his day at noon of the civil day; and we are glad to find given at some length the opinions of such authorities as Struve and Oppolzer.

Professor Struve, director of the Pulkowa observatory, in a pamphlet[1] of twenty-seven pages, gives a very interesting account of the causes which led to the international conference, and the results which it reached. In regard to the change in the beginning of the astronomical day, he thinks that the question before astronomers is not only of giving up a long-established custom, with consequent changes of rules of many years' standing, but it also involves a serious interruption of astronomical chronology. Without a doubt, the astronomer would have to make a decided sacrifice in conforming to the wish of the conference; but, after all, this sacrifice is no greater than our forefathers made when they changed from the Julian to the Gregorian calendar, — a sacrifice to convenience of which we are still made sensible whenever we have occasion to go back to early observations.

We need have little hesitation in making a similar sacrifice, if it will prevent discordance between the civil and scientific custom of reckoning time, particularly troublesome where astronomical establishments come in contact with the outer world.

Professor Struve states that the Pulkowa observatory is prepared to adopt the new time, the only question being as to the epoch when the change should be introduced in the publications of the observatory. He is inclined to recommend that this should be deferred until some agreement can be reached by astronomers, and until the new time is adopted in the Ephemerides. This might be for the year 1890, or perhaps, better still, at the beginning of the next century.

Professor Oppolzer has contributed a paper on the proposed change of the astronomical day to the March number of the *Monthly notices of the Royal astronomical society* (vol. xlv. pp. 296–298). He says, "When once such a universal time is introduced for all purposes, it is quite natural that the question must arise, if there is indeed so great a necessity to retain in astronomy, and only in astronomy, a different reckoning of time. I fail to see this necessity, and I do not think that it would cause any serious trouble or confusion if a change were to be made in our astronomical reckoning; whilst a special mode of reckoning time in one science only, when all others use the generally adopted standard, will, without doubt, be a source of error and confusion." He then takes up in some detail the objections urged against the proposed change by Professor Newcomb in a previous communication to the same publication (vol. xlv. pp. 122, 123), and he discusses the changes which would be necessary in the Ephemerides. Professor Oppolzer proposes to give practical effect to his views by adopting the new reckoning of time in an extensive list of eight thousand solar, and fifty-two hundred lunar, eclipses which he is now preparing for publication.

It is difficult to see how this matter will finally be decided. It is evidently a question for astronomers to settle among themselves; but so far they seem to be very evenly divided. For instance: out of some twenty-seven astronomers whose opinions, more or less decided, have been accessible for a count, thirteen seem inclined to favor the proposed change, while fourteen are opposed to it. And among

[1] Die beschlüsse der Washingtoner meridianconferenz. St. Petersburg, 1885. 27 p. 8°.

the *pros* are Adams, Struve, and Christie; among the *cons*, Newcomb, Foerster, and Auwers.

W. C. W.

THE NATIVES OF AMERICA.[1]

THE native population (before the changes wrought by the European conquest) of the great continent of America, excluding the Eskimo, present, considering the vast extent of the country they inhabit, and the great differences of climate and other surrounding conditions, a remarkable similarity of essential characters, with much diversity of detail.

The construction of the numerous American languages, of which as many as twelve hundred have been distinguished, is said to point to unity of origin; as, though widely different in many respects, they are all, or nearly all, constructed on the same general grammatical principle, — that called polysynthesis, which differs from that of the languages of any of the old-world nations. The mental characteristics of all the American tribes have much that is in common; and the very different stages of culture to which they had attained at the time of the conquest, as that of the Incas and Aztecs, and the hunting and fishing tribes of the north and south, which have been quoted as evidence of diversities of race, were not greater than those between different nations of Europe — as Gauls and Germans on one hand, and Greeks and Romans on the other — in the time of Julius Caesar. Yet all these were Aryans; and, in treating the Americans as one race, it is not intended that they are more closely allied than the different Aryan people of Europe and Asia. The best argument that can be used for the unity of the American race, using the word in a broad sense, is the great difficulty of forming any natural divisions founded upon physical characters. The important character of the hair does not differ throughout the whole continent. It is always straight and lank, long, and abundant on the scalp, but sparse elsewhere. The color of the skin is practically uniform, notwithstanding the enormous differences of climate under which many members of the group exist. In the features and cranium certain special modifications prevail in different districts, but the same forms appear at widely separated parts of the continent. I have examined skulls from Vancouver's Island, from Peru, and from Patagonia, which were almost undistinguishable from one another.

Naturalists who have admitted but three primary types of the human species have always found a difficulty with the Americans, hesitating between placing them with the Mongolian or so-called 'yellow' races, or elevating them to the rank of a primary group. Cuvier does not seem to have been able to settle this point to his own satisfaction, and leaves it an open question. Although the large majority of Americans have in the special form of the nasal bones, leading to the characteristic high bridge of the nose of the living face, in the well-developed superciliary ridge and retreating forehead, characters which distinguish them from the typical Asiatic Mongol, in many other respects they resemble them so much, that, although admitting the difficulties of the case, I am inclined to include them as aberrant members of the Mongolian type. It is, however, quite open to any one adopting the negro, Mongolian, and Caucasian as primary divisions, to place the American apart as a fourth.

Now that the high antiquity of man in America, perhaps as high as that which he has in Europe, has been discovered, the puzzling problem, from which part of the old world the people of America have sprung, has lost its significance. It is quite as likely that the people of Asia may have been derived from America, as the reverse. However this may be, the population of America had been, before the time of Columbus, practically isolated from the rest of the world, except at the extreme north. Such visits as those of the early Norsemen to the coasts of Greenland, Labrador, and Nova Scotia, or the possible accidental stranding of a canoe containing survivors of a voyage across the Pacific or the Atlantic, can have no appreciable effect upon the characteristics of the people. It is difficult, therefore, to look upon the anomalous and special characters of the American people as the effects of crossing, as was suggested in the case of the Australians, — a consideration which gives more weight to the view of treating them as a distinct primary division.

[1] Extract from the address of Prof. W. H. FLOWER as president of the Anthropological institute of Great Britain.

CLAUS'S TEXT-BOOK OF ZOÖLOGY.

IT is an interesting and sad fact that England and America have not as yet produced one really good manual of zoölogy, while Germany has at least two of the first order. One of these, Professor Claus's 'Grundzüge der zoologie,' has reached its fourth edition, with every probability that a fifth will soon follow. The last edition contains about fourteen hundred pages. Its large size makes it unwieldy for the beginner, and, moreover, there are no figures. By shortening especially the descriptions of orders and families, and some further condensation, the book was reduced to about eight hundred pages, and space saved for about the same number of figures. The new book thus formed is the 'Lehrbuch der zoologie,' translated under the above title. In all Professor Claus's writings, one cannot fail to notice his judicial fairness. The discussion of Darwinism (vol. i. pp. 139-179) is especially remarkable for its impartiality and candor, as well as its clearness and condensation. The arrangement of material in the general part, and the descriptions of the types, show the comprehensiveness of his mind and the extensiveness of his knowledge, while his exact-

Elementary text-book of zoölogy. By Dr. C. CLAUS and ADAM SEDGWICK, with the assistance of F. G. HEATHCOTE. 2 vols. New York, *Macmillan*, 1885. 8°.

ness in details is as clearly apparent in every one of the sharp and terse definitions. These present the few characteristics which apply to the whole group, and only that group, rarely extend beyond three lines, and are expressed in words as well chosen as the characteristics themselves. As the student follows them from type to family, he sees clearly that the animal kingdom is really a cosmos, not the chaos which is presented in too many of our zoölogies. Under each type, class, and order, each organic system, the embryonic development, and the habits of the group are described in the same clear, brief terms. Thus one can study the fourteen hundred pages of the 'Grundzüge,' or the eight hundred of the 'Lehrbuch,' and scarcely erase five words to a page, or condense in any way the sentences, without entirely changing their meaning. How many thorns would be removed from the path of the working zoölogist if all our writers could borrow Professor Claus's sharpness of vision, and accuracy of description!

The general part of the work covers a hundred and eighty pages. Of these, a hundred and thirty are devoted to the general qualities of protoplasm, the structure and development of cells and tissues, the general anatomy and physiology of each 'compound organ,' and embryonic development. The next fifty pages contain in brief outline the history of the science, and the discussion of the theory of evolution. This is, unlike most zoölogies, perhaps the most interesting and striking portion of the book, especially as in this part the genius of the author, in the choice and arrangement of material, is the plainer because of the greater liberty here possible. As specially interesting, might be noticed the author's views of parthenogenesis (p. 106) as a reproduction, on the part of agamic females by true eggs, "by no means to be relegated to the category of germ-cells," — views quite opposed to the quotations from English writers so common in our American literature, although Professor Claus seemed to be supported by Balfour and a majority of the German school.

Under Protozoa in the special part, the Monera are disregarded as a separate group, and merged with Rhizopoda and Flagellata. Thus neither nucleus nor pulsating vesicle is considered a necessary characteristic of Rhizopoda. The Flagellata are provisionally classed under the Infusoria, with expressed doubts of their animal character. Among the Flagellata are reckoned the Astasiadae (Euglena) and the Volvocinidae, although the close alliance of the latter family to the Algae is clearly acknowledged. In an appendix to the Protozoa, the Bacteria and Gregarinidae are briefly considered. It is an open question whether this is an improvement on the arrangement of forms in the 'Grundzüge,' where Bacteria, Flagellata, Myxomycetes, Catallacta, and Labyrinthuleae are all discussed in connection with Protozoa, but as groups of very doubtful position and affinities.

The study of the Coelenterata is introduced by a description of the three individual types, polyp, medusa, and ctenophore. The discussion of their resemblances and differences brings the different forms of this group clearly before the student at the outset, beside furnishing him a basis for their classification. The sponges are considered as merely a subgroup of Coelenterata.

On account of its embryonic development, Balanoglossus is assigned to an appendix at the end of the echinoderms.

Under Vermes the Nemertini are still retained with the Platyhelminthes. The Gephyrea are placed between the Chaetopoda and Hirudinea as the second sub-class of Annelida, while the Rotatoria form the fourth and last class of Vermes. This is certainly an extremely practical classification, even though some might prefer to consider the Rotatoria earlier in the series of worm-forms, on account of their general affinities.

The second volume contains, 1°, Mollusca; 2°, Molluscoidea, to which are reckoned only Polyzoa and Brachiopoda as possessing strong affinities to annelids as well as Mollusca; 3°, Tunicata; and, 4°, Vertebrata. Thus over five hundred pages of the two volumes are devoted to Invertebrata. The seven hundred figures are well chosen, and far above the average in beauty and clearness. Under every type and class are references to the latest and best literature on the subject. The translator has had a difficult task. It is no easy matter to translate into idiomatic English the author's condensed and pregnant sentences, where every word is important. A few cases might be noticed where the rendering of single words might be improved; but, as far as can be judged from a careful comparison of about thirty pages taken at random through the work, even such cases are rare, and in general the translation certainly gives a very just rendering of the author's ideas.

The publishers have given us a good page and paper, and clear type. Altogether, it is the only really satisfactory manual which we have in English, and one which no teacher or student of zoölogy can afford not to possess.

TROMHOLT'S UNDER THE RAYS OF THE AURORA BOREALIS.

'WENN jemand eine reise thuht, so kann er was erzählen,'—it must have been with this text that Tromholt sat down to write the story of his life in Lapland. He was there to study the aurora borealis; but not content with doing a goodly amount of work, and doubtless setting the results down in awe-inspiring columns of figures, he devoted a part of his time to trips to Lapp encampments near his observing station at Koutokaeino, a more extended one to the Finnish station at Sorlankyla, and another along the north coast to Boris Glebe on the Russian boundary.

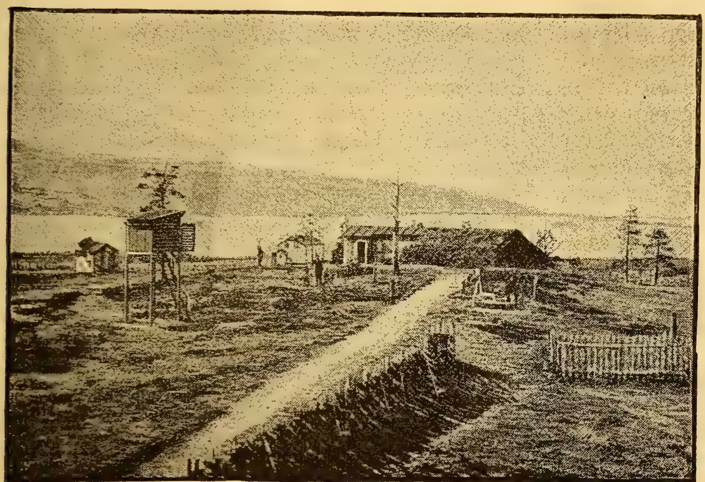


FIG. 1.—NORWEGIAN CIRCUMPOLAR STATION AT BOSSEKOP.

As a Scandinavian, he may well be proud of the scenery of southern Norway, which he refers to in the opening chapter. He says, "Dig a canal right through Switzerland, and steam down it: that would give some idea of the voyage along the coast of Helgeland, Lofodden, and Finnemarken." It may be even unjust to refer to Norwegian waters as canals, but still most will catch the author's meaning.

Bossekop was the name of the place where Tromholt and his party finally left the steamer which had brought him from Bergen. This hamlet is north of the arctic circle, and lies at the head of the Alten Fiord. We are somewhat surprised at our author's statement that Bossekop is surrounded by green hills with soft outlines, as most northern landscapes remind one strongly of the top of Mount Washington; and we are not much re-assured by the picture given of the place, which shows the usual assortment of barren boat-houses, and the trader's house and stores. One frame-house and its adjuncts constitute a hamlet in Norway.

Under the rays of the aurora borealis: In the land of the Lapps and Kvaens. By SOPHUS TROMHOLT. 2 vols. London, *Low*, 1885.

It was in June, 1882, the party landed, and began the preparations for their series of observations, which were to be continued from Aug. 1, 1882, for one year. The description given of the routine at the station is not of such a character as to lead one to be anxious to emulate the work of such explorers. To sit blinking by the fire, waiting for the appointed hour, and then to venture out with a cup of hot water for the wet-bulb thermometer, in one hand, and an oil-lamp in the other, to spend a few minutes reading the thermometer and barometer, and sketching the aurora, and roughly measuring its position; and to return to the fireside, at last, with nearly frost-bitten fingers and a frozen lamp no longer burning,—this surely is not an alluring existence. But hour after hour the operation was gone through with, first by one, and then by another, of the party.

Tromholt himself left the main party at Bossekop, and travelled south about 63 miles to Koutokaeino. His reason for doing this was, that, by observations at the two stations

FIG. 2.—TROMHOLT'S THEORY OF AN AURORAL RING.

of the same auroral arch, some estimate might be formed of the height at which the auroral light is formed.

In a chapter of ninety odd pages, Tromholt reviews the theories of the aurora, classifies as best he can the different phenomena connected with them, and gives his own ideas in regard to what is actually going on when we see a

display of northern lights. A number of illustrations are given; but in all cases they are reproduced from drawings, as, even with the most sensitive plates, he utterly failed in getting any impression on a negative. He holds the opinion that the fundamental phenomenon is a ring of light encircling the earth, as shown in fig. 2, and that all the various forms observed are due to modifications and imperfections in this ring. To the streamers he gives the position which a dipping-needle would take, and explains their apparent coming-together at the magnetic zenith, as they do occasionally, as due to perspective. He believes in such cases that the observer is looking into a tube of rays.

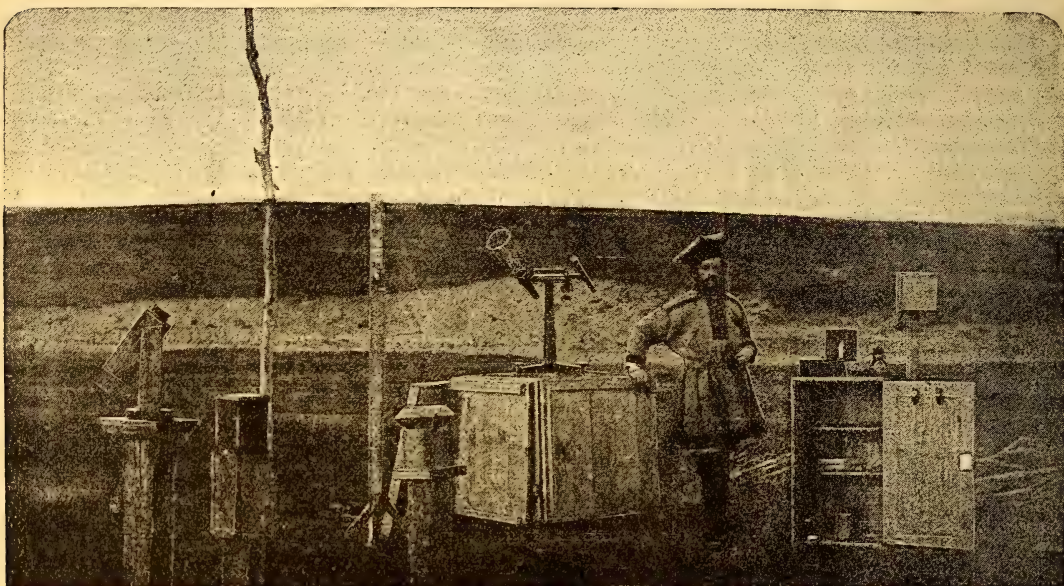


Fig. 3.—Tromholt's auroral station at Koutokaeino.

The geographical distribution of the aurora is described, and the results of the various estimates of the height given, Tromholt's own measurements making the average height of the lower edge of a number of auroral arches 70.2 miles. The connection of the aurora with the sun-spot periods is referred to, and a bi-yearly variation in the phenomenon is made probable. The crackling sound sometimes said to have been heard, Tromholt was led to consider imaginary. As regards the strength of the light emitted, he says that at times he was able to read print of the following size:—

Aurora borealis.

In the account of his journey in the spring of 1883 to the Finnish polar station, Tromholt takes occasion to criticise the artificial aurora which Professor Lemström succeeded in getting on the top of a hill. He thinks the light more of the nature of St. Elmo's fire than a true aurora. He also takes exception to Lemström's determinations of the height.

Koutokaeino was the seat of a religious excitement among the Lapps, which finally culminated in 1852 in the murder of the trader and sheriff of the place, the pastor's life being saved only by the timely advent of a few armed and sane Lapps from a neighboring village. A somewhat similar excitement was in 1883 brewing at Hätta to the east of Koutokaeino.

The most of Tromholt's trips over the country were made in reindeer-sleds, when the snow was hard, and were accomplished with few more than the usual mishaps of such travelling, although his St. Bernard dog, Rolf, did not prove a congenial companion for the deer. But the final journey, to Sodankyla, was made when the sun had already begun to melt the snow; and, on his return, Tromholt pictures himself as dragged through from one to two feet of water for a great part of the way. In the spring the land must resemble one vast mud-puddle. Finally Tromholt returned to civilization, and took his voyage along the north coast of Scandinavia.

Thanks to the cheap photo-engraving pro-

cesses employed, the book is well supplied with authentic illustrations, although some of them are not very clear, — a fault doubtless due to imperfections in the original photographs.

SOME STATE GEOLOGICAL REPORTS.

MINNESOTA is not only the centre, but it is also the summit of the continent, in the sense of being the starting-point of the three most important systems of drainage in North America. But, notwithstanding its geographic position, the mean altitude of the state is less than thirteen hundred feet, and its surface configuration presents the simplicity and monotony of a level and thoroughly glaciated region; while the geological structure of the greater portion of the state is hopelessly buried under a thick and almost unbroken mantle of drift. These circumstances greatly diminish the labors of the geologist; and it is at first a matter of surprise that ten years should have elapsed between the inception of the survey and the completion of this first volume of the final report. But this is readily explained by the very economical administration of the survey, the geological corps consisting of the director and one assistant, and, during a considerable part of the time represented by this volume, of the director alone.

The introductory chapter is an extended and admirable historical sketch of explorations and surveys in Minnesota and the adjacent states, from the times of Champlain, Duluth, Hennepin, and La Salle, to the present survey. This historical introduction is, in its extent and general interest, unique among American geological reports. It is illustrated by several good reductions of the earlier maps of the north-west, and must prove a valuable compilation to students of history and geography as well as of geology. The account of the general physical features of the state in this volume is brief, and yet adequate, considering the topographic uniformity. But we look in vain for any generalized statement of the geological formations of the state below the drift. It is probable, however, that this chapter is reserved for a later volume; for, as stated in the preface, this volume is intended to be mainly descriptive, — a repository of facts, with only such generalizations as are self-evident or generally admitted.

The geology of Minnesota. Vol. i. of the final report. By N. H. WINCHELL, assisted by WARREN UPHAM. Minneapolis, *State*, 1884. 13+697 p., 1+31 pl. 4°.

Indiana. Department of geology and natural history. Twelfth and thirteenth annual reports. JOHN COLLETT, state geologist. Indianapolis, *State*, 1883, 1884. 400 p., 38 pl. (4) maps; 16+186 p., 39 pl., map. 8°.

The popular demand for early practical results is well met in the excellent chapter on the building-stones, which constitute, at present, the most important field of the economic geologist. The descriptions are plain and simple, with the condensed statements of the microscopic characters in fine print. The use of 'syenite' as a name for hornblendic granite is, however, antiquated, and without the sanction of the leading lithologists of this country and Europe. The table in which the descriptions of forty-one of the most important building-stones are condensed and compared would be a model of its kind, if the mineralogical composition of the stones were included. It shows at a glance, that, in crushing-strength and durability, the building-stones of Minnesota are probably not surpassed by those of any state in the Union.

The main part of this volume (about five hundred pages) is devoted to detailed accounts of the geology of the state by counties. Of the eighty counties in the state, twenty-eight, including nearly all that part of the state south of the Minnesota River, are here mapped and described, two-thirds of this work being credited to Mr. Upham. In some instances the descriptions of several counties have been combined; and, if this plan had been more generally adopted, much needless repetition might have been avoided, and the monotony of this part of the volume greatly relieved.

The two annual reports of the state geologist of Indiana contain comparatively little in the way of original contributions to the geology or natural history of the state. The most important sections of the reports are those on the paleozoic corals, and the subcarboniferous fossils of Spergen Hill, by Professor James Hall; the paleozoic flora, by Professor Lesquereux; and the fauna of the Indiana coal-measures, by Dr. C. A. White. These papers consist of short specific descriptions, with seventy-one plates of figures. Very few of the species are new to science, or peculiar to Indiana, while a considerable number are not found in that state. These articles are really compilations from the reports of other states and more general sources; and, although doubtless of some value as reference-manuals of the paleozoic fauna and flora, it is a question to what extent such publications are really germane to the purposes of a geological survey. Each volume contains several short county reports, and in these and other chapters the economic features have special prominence. But the treatment is not always impartial, for there is a manifest tendency in some parts to

unduly extol the good features of the state and the importance of the geological survey. The report for 1882 contains a catalogue of the flora (789 species) of the Alpine or central-eastern portion of the state.

NOTES AND NEWS.

In an appendix to Professor Dexter's 'Biographical sketches of the graduates of Yale college,' Prof. H. A. Newton has given some figures showing the mortality among the graduates of the early years of the college. The graduates considered are those of the years 1702–44, 483 in all. To avoid irregularities, the results have been grouped in sets of ten years. The actual numbers of deaths are compared with the numbers computed from the American and combined experience tables.

Table showing the mortality, actual and expected, by decades of years, among Yale graduates, 1702–44.

Ages.	No. of deaths.	Mortality by American table.	Mortality by combined experience table.
14 to 25	28	18.60	17.64
26 to 35	41	36.03	36.17
36 to 45	48	37.73	40.12
46 to 55	71	46.87	54.02
56 to 65	93	68.17	77.02
66 to 75	98	93.52	97.72
76 to 85	65	83.40	79.93
86 to 95	27	51.31	37.72
96 to 103	2	–	–
Total.	473	435.63	440.34

The most noticeable fact shown by this table is that below the age of seventy the actual mortality so largely exceeded the tabular, the excess being over twenty per cent of the expected mortality. This mortality experience is decidedly different from that of the persons who have been members of the Divinity school of Yale college (*New-Englander*, April, 1873). For them, between the ages of forty and seventy, the tabular *exceeded* the actual mortality by nearly forty per cent of the former. This enormous difference is quite uniformly distributed, and is evidently not principally due to chance. It cannot be due to great difference in the two groups of men. It must rather be ascribed to a difference in the habits of living in the eighteenth and nineteenth centuries.

— It appears from *Nature* that preparation is already making for the meeting of the British association in Birmingham in 1886. It is stated that the meeting will probably be under the presidency of Sir William Dawson of Montreal.

— Dr. Andrée of Leipzig, according to *Nature*, discussed before a recent meeting of the Anthropological society of Vienna the question whether iron was known in America in pre-Columbian times. Meteoric iron was certainly in use amongst certain Indian tribes and the Eskimo, but Dr. Andrée thinks that they were wholly unacquainted with the art of forging iron. This conclusion is based on the fact, among others, that while there is ample proof that the Indians [the author under this term is including the Mexicans and Peruvians] knew how to obtain and employ gold, silver, tin, copper, quicksilver, etc., we hear nothing of iron-mines in the history of the civilization of ancient America. The language itself proves this, for there is no expression for *iron.* Some writers, it is true, speak of the word *panilgue* as that for iron, but it really means metal in general. Moreover, in prehistoric, or rather pre-Columbian, graves, especially in the rainless regions of Peru and northern Chili, ornaments of all kinds, weapons, and implements are found; but no objects in iron have been discovered, although the Indians placed their most valued articles in their tombs. [Meteoric iron has, however, been found in several mounds in Ohio by Mr. F. W. Putnam of the Peabody museum in Cambridge, both in a natural state and hammered; in the latter form used for the same purposes as native copper, both for implements and ornaments.] Dr. Andrée thinks there is no reason to believe that the tools employed in the great masonry-works of Peru, such as that at Tiahuanaco, were other than those in use in the rest of Peru, which were of *champi*, a species of bronze. The chisels found in Peruvian graves soon become blunted when used on the hard strut; but it is suggested that there was some method of sharpening them easily. Indians certainly have worked a hard stone like nephrite without iron; and there is no improbability, says the writer, in the theory that these chisels were employed, when we recollect the patient temperament of the Indians, who for generations were accustomed to the repetition of the same work, to indolently pursuing a uniform task, and also that *gutta cavat lapidem.*

— Dr. G. A. Fischer, in his proposed journey to Lado on the upper Nile, will start, according to the *Athenaeum*, from Pangani, and endeavor to open up a direct route to Speke Gulf. His movements after arriving in Uganda will depend upon circumstances. It is just possible, that, owing to the proceedings of a German colonization society, Dr. Fischer may not find it easy to recruit carriers at Zanzibar. In a paper which he read at the German geographical congress at Hamburg, Dr. Fischer spoke sensibly against some of the utopian schemes of his countrymen. He pointed out more especially that Europeans cannot become acclimatized in equatorial Africa, except perhaps at an altitude of more than five thousand feet, and that even the interior tablelands are free from malaria only where they are barren, and consequently useless for purposes of colonization.

— Twenty-three maps, fourteen by seventeen centimetres, of excellent execution, clear and not overcrowded lettering, form a most convenient pocket atlas, the twenty-first edition of which, entirely remodelled, has just been issued from the geographical establishment of Justus Perthes in Gotha. For a European tourist, nothing could be more convenient, as more than half the maps relate to that continent, and only three to North America and the United States

— The Parker memorial science class of some seventy members has just closed its course of weekly lectures or lessons. These were of a very varied character, being given by some twenty-five persons on successive Sundays, on a great variety of topics. The enterprise of the promoters in securing in many cases excellent speakers is to be commended; but one fails to see any harmony in the general plan, and can therefore only question its utility, beyond satisfying a dyspeptic craving for miscellaneous information.

— An international pharmaceutical congress is to be held in Brussels from Aug. 31 to Sept. 6. The principal subjects of discussion are to be: 1. An international pharmacopeia; 2. Pharmaceutical education; 3. Adulteration of food; 4. Drinking-water and its properties and circumstances. The language used will be French, and the king of the Belgians will be president of the congress.

— On the 4th of July, 1883, during the voyage from Lisbon to Plymouth, a bottle containing a paper was thrown overboard from the German gunboat Cyclop in latitude 39° 41.8′ north, and longitude 9° 41′ west. This was afterwards picked up on the 1st of March, 1885, on the east side of Grand Turk Island, West Indies. This bottle had been afloat one year and eight months, and had probably travelled back and forth in the North African and north equatorial currents. Through the German embassy in Portugal the German seewarte has received a bottle-post paper which was put overboard on the 4th of December, 1884, by the German bark Nubia during a voyage from Rotterdam to Zanzibar, in latitude 16° 13′ north, longitude 21° 53′ west. This was afterwards picked up near Sal Island, Cape de Verdes, in about latitude 16° 52′ north, and longitude 22° 55′ west. The date of the finding of the bottle was not given. The paper was handed to the German consul at Sal Island by the harbor authorities of that place on the 1st of March, 1885. It is likely that this bottle travelled about 70 sea-miles N.W. by W. $\frac{1}{8}$ W. in $2\frac{1}{2}$ months. It is also probable that it lay ashore for some time before it was found, or that considerable time elapsed before the paper was delivered to the German consul. Through the German consulate in Rochefort, France, the same institution has received a bottle-post paper which was put overboard from the German schooner Milly, July 25, 1884, during the voyage from Hamburg to the Marshall Islands, in latitude 48° 18′ north, longitude 6° 48′ west. This was afterwards picked up on the coast on the 14th of February, 1885, in latitude 46° 27′ north, longitude 2° 42′ west. It is probable that this bottle travelled 202 sea-miles S.E. by E. in 204 days. The seewarte has also received a bottle-post paper from Corpus Christi, Tex., which had been put overboard from the German steamer Kronprinz Friedrich Wilhelm, Dec. 26, 1882, in latitude 1° 37′ north, longitude 30° 43′ west. This was afterwards picked up on the 1st of June, 1884, near Padre Island, coast of Texas, in about 27° north latitude, 97° 15′ west longitude. This bottle had probably travelled 4,160 sea-miles W.N.W $\frac{1}{8}$ W. in 523 days.

— Dr. Bernard Schwartz has written a painstaking work on the history of mountain investigation from ancient times to the days of De Saussure ('Die erschliessung der gebirge,' Leipzig, 1885), based on his lectures at the Freiberg mining school. It carries the reader through the early centuries of travel in rugged countries, when mountains were merely obstacles, not objects, in the road; through the middle centuries, when attention to nature was awakening, but when observation was still so uncritical that Teneriffe, for example, was reported nine miles, and even fifteen miles high; and into the modern era, which, so far as accurate measures of altitude are concerned, began in the famous meridian-arc expedition of Bouguer and La Condamine to Peru in 1735. Up to this time Mont Blanc was the 'monarch of mountains,' just as the Alps were the mountains, *par excellence*, of the world; but then Chimborazo took the lead, and held it till 1818, when the English explorations brought the peaks of the Himalaya up to the first rank. The progress and results of mountain exploration are thus minutely chronicled in about five hundred pages, themselves almost pathless, as the table of contents is very brief, and index, page-headings, and paragraph-headings are quite wanting.

— Professor Nowacki of the Polytechnic institute in Zurich has prepared an introduction to the study of soils ('Kurze anleitung zur einfachen bodenuntersuchung,' Zurich, 1885), from which we may measure the attention given to scientific agriculture in Switzerland. It gives a general statement of the structure of soils, and of the method of taking samples, and then proceeds to treat the analysis and classification of soils more at length, and to discuss the determination and supply of needful elements. It is all treated as simply as possible, so as not to be too inaccessible to those who have most need of its teachings. A supplement, however, gives 'the first attempt at a scientific terminology of soils,' which we fear will not soon enter into common use. Seven genera, of six species each, from Terra rudecta limosa aut margillosa to Terra humosa agrestis et hortensis, is at least somewhat cumbersome.

— An extended list of altitudes for nearly three thousand places in the Carnic and Julian Alps has lately been compiled by G. Marinelli, professor of geography in the University of Padua, and published as a supplement to the *Cosmos* of Guido Cora of Turin. It is preceded by a list of a hundred and nineteen authorities, forming in itself a guide to the geographic literature of the region, and is introduced by a well-analyzed table of contents, from which any desired point can easily be found.

— Dr. G. M. Dawson has recently discovered a remarkable Jurasso-cretaceous flora in the Rocky Mountains, on the branches of the Old Man River, Martin Creek, Coal Creek, and one other locality far to the north-west on the Suskwa River. The containing rocks are sandstones, shales, and conglomerates, with seams of coal, in some places anthracite. It was proposed by Sir William Dawson, in his paper before the recent meeting of the Royal society of Canada, to call

these beds the Kootanie group, from a tribe of Indians who hunted over that part of the Rocky Mountains between the 49th and 52d parallels. The beds lie in troughs in the paleozoic formations of the mountains, and may be traced for a distance of a hundred and forty miles north and south. The plants found are conifers, cycads, and ferns, the cycads being especially abundant. Some are identical with species described by Heer from the Jurassic of Siberia, while others occur in the lower cretaceous of Greenland. No dictoyledonous leaves have been found in these beds, which connect in a remarkable way the extinct floras of Asia and America and those of the Jurassic and cretaceous periods.

— In an article on the variations of personality, in the *Journal de Genève*, Dr. Hermann Fol mentions three elements of personality, — consciousness, memory, and volition. Of the first there are several kinds, notably consciousness of sensation, where the sensation proper must be distinguished from our consciousness of it. If the latter is lost periodically, and the condition alternates at regular intervals with the normal state, a sense of double existence is produced; and the same state arises when consciousness of sensation is carried to an extreme. In regard to the memory, a person sometimes seems to have two distinct memories which act alternately. The duplication is particularly noticeable in the case of somnambulists. If it occurs in a state of wakefulness, the person seems to have two distinct personalities. Only the normal memory forms an element of the personality. The personality may also be altered by a change in our idea of the future. Absent-mindedness, and yielding to involuntary impulses, are the outward signs of this kind of mental disease. In conclusion, Dr. Fol thought men differed less in the extent of their faculties than in the extent of their consciousness of them.

— An aeronautical exhibition under the patronage of the Aeronautical society of Great Britain was to be opened, says *Nature*, during the present month, in connection with the International exhibition at the Alexandra palace. The large out-door space will be made available for various competitions. The disputed question of aerial locomotion by the aid of buoyancy will be tested. Possibly the fire in the building in the early part of June may interfere with the plans.

— A course of ten lectures on the practical analysis of plants was finished on June 20 at the Cincinnati society's rooms. They were given by Jos. F. James, and were instituted for the special benefit of the teachers in the public schools. They were free to those invited, and were attended by from fifteen to twenty teachers. The society proposes to give similar courses of lectures on Saturday mornings in the fall. The first one will probably be on physiology and hygiene, followed by one on physical geography.

— We regret to notice the death of Rev. T. W. Webb at Hardwick, Eng., on the 19th of May. He is known everywhere to astronomers, to amateur astronomers in particular, as the author of 'Celestial objects for common telescopes,' — a book which is said to have "done more to interest observers in the heavens than any other book that has been published." He was a frequent contributor to *Nature*, the *Intellectual observer*, the *English mechanic*, etc. One of his most recent works was a popular book on the sun. We learn from the *Astronomical register* that he was appointed a prebendary of Hereford Cathedral in 1882; and, if he had lived a few weeks longer, he would have completed his eightieth year.

— Entomologists will be sorry to learn of the death, on the 15th inst., at his home in Morgantown, N.C., of Mr. H. K. Morrison, a noted collector of insects, probably the most successful and enthusiastic in this line of any we have had. A large proportion of his collections went to Europe, where they were eagerly sought; and the literature of descriptive entomology for the last ten years in this country shows everywhere the indications of his zeal.

— A correspondent of the *English mechanic*, writing from Morchain, Somme, France, says, "A boiler of a new system, which received the name of *générateur tricyclique inexplosible*, has been invented, which differs from all those hitherto produced. The metallic surface submitted to the action of the fire does not touch the water; in no condition can the boiler get red-hot; it is enveloped all over by the same temperature: hence an immense vaporization; and steam can be produced to the very last drop of water without the least danger."

— Jules Garnier has designed an elevated railway for the city of Paris, which it is expected will be in running order in time for the exposition of 1889. It will be twenty-eight thousand eight hundred metres (about eighteen miles) in length, and will cost ten millions of dollars. The structure will be composed of two tracks, one above the other, on an iron frame. The whole will be fifteen metres from the building-line, and vibrations will be guarded against by special appliances. The trains will be composed of three American cars, each fourteen metres in length, and two platform or open cars. They will run every five minutes for seventeen hours each day, and will have branches connecting with the several railway-stations.

— A new volume of memoirs of the Siberian section of the Russian geographical society contains a description of Lake Balkhash by Fischer, an account of the Vassiugan tundras, a list of geographical positions determined by Lebedeff, and other documents of importance.

— Vesque's 'Traité de botanique' (Paris, *Baillière*), which was written, as the author states, as supplementary to lectures delivered at the Institut agronomique, is prefaced by a brief review of the characters of classificatory value in botany, but is in the main a concise synopsis of the phenogamic orders of importance. The scientific reputation of its author is a sufficient guaranty of its accuracy; and the information it contains is rendered easily accessible by a complete index to the illustrations and specific descriptions, and to the principal products mentioned.